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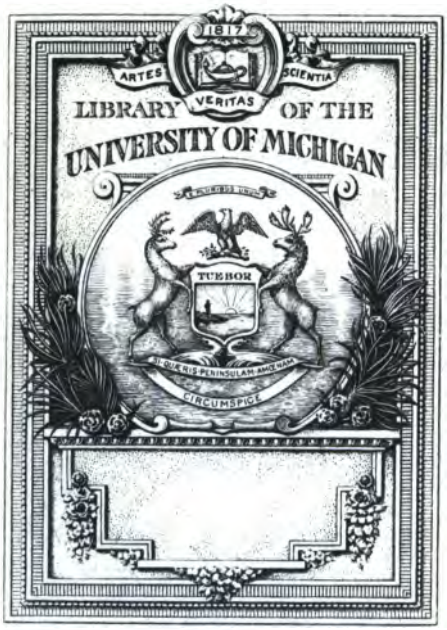
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TREATISE

ON

GUNTER'S SCALE, AND THE SLIDING RULE:

TOGETHER WITH A

DESCRIPTION AND USE,

OF THE

SECTOR, PROTRACTOR, PLAIN SCALE, AND LINE OF CHORDS;

OR

AN EASY METHOD OF FINDING THE AREA OF SUPERFICES; AND OF MEASURING BOARDS; AND OF FINDING THE SOLID CONTENTS OF BODIES, ESPECIALLY THAT OF TIMBER, BY THE SLIDING RULE; AND ALSO OF GUAGING CASKS, AND ROUND TIMBER.

TO THESE ARE ADDED SEVERAL USEFUL LOGARITHMICK TABLES, TABLES OF LATITUDE AND DEPARTURE, AND A TABLE OF NATURAL RADII, NOT KNOWN TO HAVE BEEN HERETOFORE PUBLISHED: ALSO A TABLE OF ROUND, AND SQUARE TIMBER.

BY GEORGE CURTIS, MATH.

WHITEHALL, N. Y.
PRINTED AND PUBLISHED BY E. ADAMS.
1824.

District of Vermont,—To Wit.

BE IT REMEMBERED, That on the twenty-seventh day of May in the forty-eighth year of the Independence of the United States of America, GEORGE CURTIS of the said district, hath deposited in this office the title of a book, the right whereof he claims as author, in the words following, to wit: "A treatise on Gunter's Scale, and the Sliding Rule, together, with a description and use of the Sector, the Protractor, Plain Scale, and Line of Chords; or an easy method of finding the area of superfices, and of measuring Boards and finding the solid contents of bodies, especially that of timber, by the Sliding Rule, and also of gauging Casks and Round Timber. To these are added several useful Logarithmick Tables, Tables of Latitude and Departure, and a table of Natural Radii, not known to be heretofore published. By GEORGE CURTIS, Math." In conformity to the Act of Congress of the United States, entitled "an act for the encouragment of learning, by securing the copies of maps, charts, and books to the authors and proprietors of such copies, during the times therein mentioned."

JESSE GOVE,
Clerk of the District of Vermont.

A true Copy of Record, examined and sealed by
J. GOVE, *Clerk.*

Hist. & Geo.
Tuttle
1-21-35
26926

PREFACE.

The primary design of this Treatise, is to introduce a more general attention to, and knowledge of the instruments herein described. Notwithstanding the many books that are daily issuing from the press, on other subjects, yet I have known of none that can preclude the benefits of a work of this kind. The author was led into these views by journeying through many parts of the United States, and finding a work on the subject here treated of, very much needed. It is designed as a pocket companion, for the Surveyor, Mechanick, and for those who deal in timber and boards, particularly by its tables of round and square timber, for the Wheelright, the Housecarpenter, Joiner, Cooper, and many other Dealers and Craftsmen, as well as the Grocer, for gauging expeditiously. How far the author has succeeded in his views, and endeavours to render it useful to mankind, must be decided by the test of experience.

DA 2-13-40

RECOMMENDATIONS.

Having duly examined the inclosed work, in manuscript, I am constrained and deem it proper, to recommend it to the patronage of a generous publick, as being a valuable and useful production; valuable from its tendency, to bring into general use, that which has, hitherto, been known to but few; useful, in vastly abridging the labour of Arithmetical and Mathematical calculations, that the surveyor and artist have frequently to make, also in containing some things, never before known to have been published.

CYRUS CARPENTER,
Physician, and Mathematician.

Whiting, Vt. May 24, 1824.

Having been thoroughly convinced by daily experience that a work like the present was much needed as well by the mechanick as by the mathematician and the surveyor, it was with no inconsiderable degree of interest that I gave it a perusal. After having attentively and minutely examined it, I find that the author has correctly anticipated the defects of works of this description in use, and has admirably supplied them. He has not only very much abridged the labour of many mathematical estimations; and simplified many processes which were formerly tedious and perplexing; but has embodied in his work many interesting facts which are original; or at least not to be found in similar productions. Upon the whole, I consider the work well calculated to promote the interests of mathematical science, and sincerely hope it will meet with that liberal reception from an intelligent publick, which its merits deserve.

SAMUEL BEACH, *County Surveyor.*
Addison County, Vt.

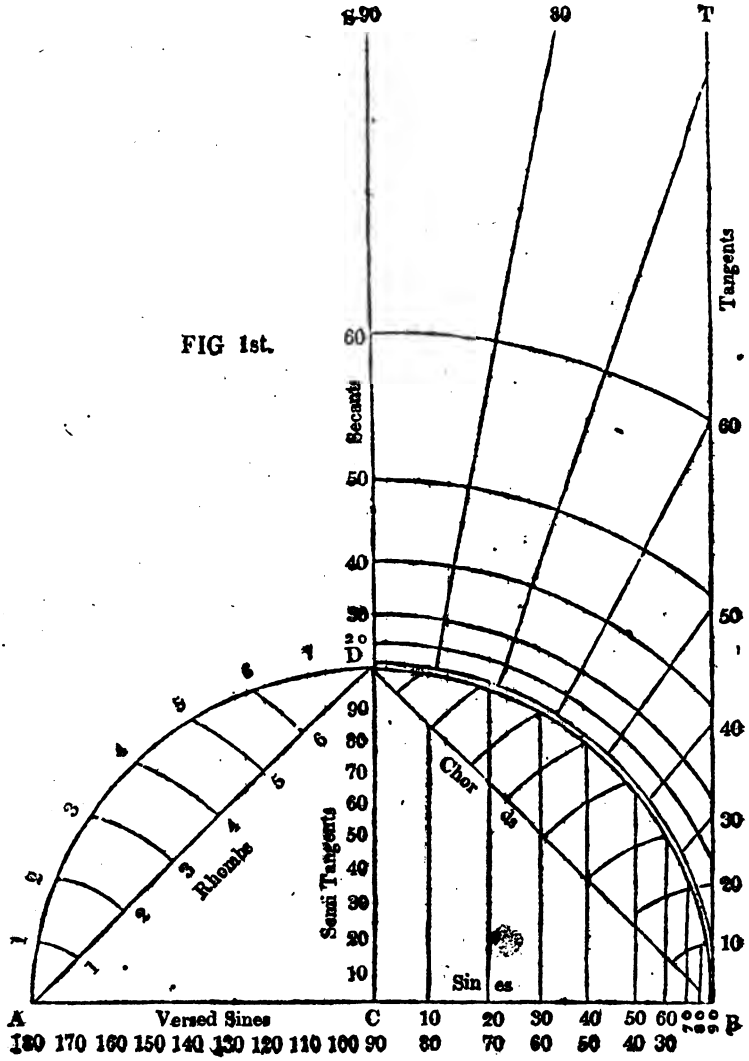
We, the subscribers, have perused with some degree of pleasure, a Treatise on Gunter's Scale, &c. prepared for the press, by George Curtis, and have minutely exam-

ined that part which relates to the measurment of timber and boards by the Sliding Rule, and do cheerfully recommend it as being an easy and concise way of getting the contents of solid bodies of every description; and the ready calculated tables of round and square timber which never have appeared in any work of this kind, cannot fail to render it valuable to all those who deal in lumber.

ISAAC COLLINGS,
Inspector of Lumber.
ASA EDDY.

Whitehall, August 24, 1824.

FIG 1st.



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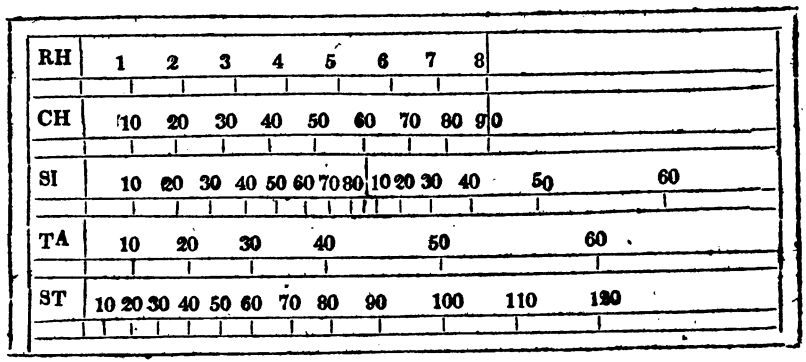
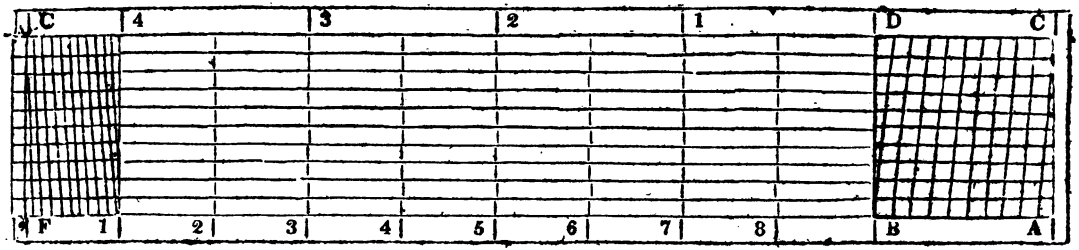
PLAIN SCALE, FIG 2d.



DIAGONAL SCALE, FIG 3d.



CONSTRUCTION OF THE PLAIN SCALE.

1. With the radius intended for the scale, describe a semicircle, (see plate 1st fig 1st,) and from the centre C, draw CD, perpendicular to AB, which will divide the semicircle into two quadrants, AD, BD; continue CD towards S, draw BT, perpendicular to CB, and join BD and AD.

2. Divide the quadrant BD into 9 equal parts, then each of these divisions will be 10 degrees. Subdivide each of these parts into single degrees, and if your radius will admit of it, into minutes, or some equal parts of a degree, larger than a minute.

3. Set one foot of the compasses at B, and transfer each of the divisions of the quadrant BD, to the right line BD, then BD will be a Line of Chords.

4. Then the points, 10, 20, 30, &c. in the quadrant BD, draw right lines, parallel to CD, to cut the radius CB, and they will divide that line into a line of sines, which must be numbered from C towards B.

5. If the same line of sines be numbered from B towards C it will become a line of versed sines, which may be continued to 180 degrees, if the same divisions be transferred on the same line on the other side of the centre C.

6. From the centre C, through the several divisions of the quadrant BD, draw right lines till they cut the tangent BT so the line BT, will become a Line of Tangents.*

7. Set one foot of the compasses at C, extend the other to the several divisions, 10, 20, 30, &c. in the tangent line BT, and transfer these extents, severally, to the right line CS, then that line will be a Line of Secants.

8. Right lines draw from A to the several divisions 10,

* A mistake was made in engraving this plate. The lines running parallel with C D, and the curved lines between B D, and the lines falling from the Tangents should intersect each other on the semicircle A D B; and the last mentioned lines should run in a direction to centre at C.

20, 30, 40, &c. in the quadrant BD will divide the the radius CD into a line of semi-tangents.

9. Divide the quadrant AD into 8 eqnal parts, and from A as a centre, transfer these divisions severally into the line AD, then AD will be a Line of Rhombs, each division answering 11 degrees and 15 minutes upon the Line of Chords. The use of this division, or line, is for measuring angles, and protracting them, according to the common divisions of the Mariner's Compass. If the radius AC be divided into 100, or 1000, &c. equal parts, and the length of the several sines, tangents, and secants, corresponding to the several arches of the quadrant, be measured thereby, and these numbers set down in a table, each in its proper column, you will by these measures have a collection of numbers, by which the several cases in Trigonometry, may be solved. Right lines, graduated as above mentioned, being placed severally upon the Rule, form the instrument called the Plain Scale, (see plate 1st fig 2d,) by which the line and angles of all triangles may be measured. All right lines as the sides of plain triangles, &c. when they are considered simply as such, without having relation to a circle, are measured by scales of equal parts, each of which is subdivided into ten equal parts; and this serves as the common divisions to all the rest. In most Scales, an inch is taken for a common measure, and whatever an inch is divided into, may be found at the end of the Scale: divided in this manner, any number less than 100, may be readily taken. But if the number should consist of three places of figures, the value of the third figure, cannot be exactly ascertained; and in this case, it is better to use a Diagonal Scale, by which any number consisting of three places of figures, may be exactly found. The figures of this Scale are given in plate 1st, fig 3d; its construction is as follows: Having prepared a ruler of a convenient breadth for your Scale, draw near the edges, two right lines, AF, CC, parallel to each other; divide one of these lines, as FA into equal parts, according to the size of your Scale, and through each of these divisions, draw right lines perpendicular to AF, to meet CC, then divide the breadth into ten equal parts; and through each of these divisions, draw right lines, parallel to AF and CC. Divide the lines AB, CD, into ten equal parts, and from the point A to the

first division in the line CD, draw a right line parallel to that line; draw right lines through all their divisions, and the Scale is finished.

Besides the lines already mentioned, there is another on some Scales, and on the Gunter's Scale, marked ML, which is joined to a line of chords, and shows how many miles of Easting and Westing corresponds to a degree of Longitude in every degree of Latitude.* These several lines are generally put on one side of a Rule two feet long, and on the other side is laid down a scale of Logarithms of the sine tangents and numbers, which is commonly called Gunter's Scale, and as it is of general use, it requires a particular description, which will be found on the thirteenth page.

* As it would confuse the adjoined figure, to describe on it the line of Longitude, it is neglected; but the construction is as follows: divide the line CB, into 60 equal parts, and through each point draw lines parallel to CD to intersect the arch BD. Take B as a centre, transfer the several points of intersection, to the line BD, and their number is from D towards B, from 0 to 60, and it will be the Line of Longitude.

HOW TO PROVE THE SLIDING RULE.

RULE.—Draw out the slider to the right hand, till 1 on the slider coincides with 2 on the fixed part, then 2 on the slider will coincide with 4 on the fixed part. Continue to draw the slider till 1 on the slider coincides with 3 on the fixed part, then 2 on the slider will coincide with 6 on the fixed part; till 1 on the slider coincides with 4 on the fixed part, then 2 on the slider will coincide with 8 on the fixed part; till 1 coincides with 5, then 2 will coincide with the centre 1; till 1 coincides with 5½, then 2 will coincide with 11; till 1 coincides with 6, then 2 will coincide with 12; and thus continue to do till you have gone through the line, and if the Rule is correctly graduated, each number will correspond as above stated; if they do not correspond, the Rule is not correct, and consequently will not give a correct answer.

GUNTER'S SCALE.

Gunter's Scale has upon it eight lines :

1. Sine Rhombs, (marked SR) corresponding to the Logarithms of Natural Sines of every point of the Mariner's Compass, numbered from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7 to 8, where is a brass pin ; this line is also divided, where it can be done, into halves and quarters.

2. Tangent Rhombs, (marked TR) corresponds to the Logarithms of the tangents of every point of the Compass, and is numbered 1, 2, 3 to 4, at the right hand, where there is a pin ; and thence towards the left hand with 5, 6, 7 ; it is also divided, where it can be done, into halves and quarters.

3. The line of numbers, (marked NUM) corresponds to the Logarithms of numbers, and is marked thus : at the left hand it begins at 1, and towards the right hand are 2, 3, 4, 5, 6, 7, 8, 9, and 1 in the middle ; at which, is a brass pin ; then 2, 3, 4, 5, 6, 7, 8, 9 and 10 at the end, where there is another pin. The value of these numbers and their intermediate division, depends on the estimated values of the extreme numbers, 1 and 10 ; and as this line is of great importance, a particular description of it and its uses, will be given.

The first 1, may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly, 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned one tenth or one hundredth, or one thousandth part, &c. and then the next 2 is two tenth, or two hundredth, or two thousandth parts, &c. &c. Then, if the first 1, be reckoned 1, the middle 1 is reckoned 10 and 2, at its right hand is 20, 3 is 30, 4 is 40, and 10, at the end is 100 ; Again, if the first 1 is 10, the next 2 is 20, 3 is 30, and so on, making the middle 1, 100, the next 2 is 200, the next 3 is 300, 4 is 400, and 10 at the end is 1000. In like manner, if the first 1 be esteemed one tenth part, the next 2 is two tenth parts, and the middle 1 is one, and the next 2 is two, and 10 at the end is ten. Again, if the first 1 be counted one hundredth part, the next 2 is two hundredth parts, the middle 1 is now ten hundredth parts, the next two hundredth parts, the

middle 1 now is ten hundredth parts, or one tenth part; and the next 2 is two tenth parts, and 10 at the end is counted 1. As the figures are increased or diminished in their value, so in the like manner, must all the intermediate strokes or subdivisions, be increased or diminished; that is, if the first 1 at the left hand be counted 1, then 2 next following is 2, and each subdivision between them now is one tenth part, and so all the way to the middle 1, which now is 10, the next is 20;—now the longer strokes between 1 and 2 are to be counted from the centre 1, (11, 12,) where is a brass pin, then 13, 14, 15, sometimes a longer stroke than the rest; then 16, 17, 18, 19, 20, at the figure 2; and in the same manner the short strokes between the figures 2 and 3, and 4 and 5, &c. are to be reckoned as units. Again if 1 at the left hand be 10, the figures between it and the middle 1, are common tens; and the subdivisions between each figure are units; from the middle 1, to 10 at the end, each figure is so many hundredths: and between these figures each longer division is ten. From this description it will be easy to find the divisions representing any given number; thus, suppose the point representing the number 12, were required, take the division at the figure 1, in the middle for the first figure of 12, then for the second figure count two tenths, on longer strokes to the right hand, and this last is the point representing 12, where the brass pin is. Again, suppose the number 22, were required; the first figure begins 2, 1. Take the division to the figure 2, and for the second figure 2, count two tenths onward and that is the point representing 22. Again, suppose 1728 were required. For the first figure, 1, take the middle 1; for the second figure, 7, count onward as before, and that is 1700, and as the remaining figures are 28, or nearly 30, note the point which is nearly $\frac{3}{10}$, for the distance between the marks 7 and 8, and this will be the point representing 1728. If the point representing 435 was required: from the 4 in the second interval count towards 5 on the right, three of the larger divisions and one of the smaller, (this smaller division being midway between the marks 3 and 4,) and that will be the division expressing 435, and the like of other numbers, which by a little practice is easily done.

All fractions found in this line must be decimals, and if

they are not, they must be reduced to decimals; which is easily done by extending the compasses from the denominator to the numerator; that extent laid the same way from 1 in the middle or right hand, will reach to the decimal required.

EXAMPLE.

To find the decimal fraction equal to $\frac{3}{4}$; extend from 4 to 3, that extent will reach from 1 on the middle to 75 towards the left hand; the like may be observed of any other vulgar fraction.

Multiplication is performed on this line by extending from 1 to the multiplier, that extent will reach from the multiplicand to the product. Suppose, for example, it were required to find the product of 16 multiplied by 4: extend from 1 to 4; that extent will reach from 16 to 64, the product required.

Divsion, being the reverse of Multiplication, therefore, extend from the divisor to unity; that extent will reach from the dividend to the quotient. Suppose 64 to be divided by 4; extend from 4 to 1; that extent will reach from 64 to 16=the quotient.

Questions in the Rule of Three are solved by this line, as follows. Extend from the first term to the second—that extent will reach from the third term to the fourth, or answer.

It ought to be particularly noticed, that if you extend to the left from the first number or term to the second, you must also extend to the left from the third to the fourth, and vice versa.

EXAMPLE.

If the diameter of a circle be 7 inches, and the circumference 22 inches, what is the circumference of another circle, whose diameter is 14 inches?

Extend from 7 to 22; that extent will reach from 14 to 44, the same way.

The superficial contents of any Parallelogram are found by extending from 1 to the breadth; that extent will reach from the length to the superficial contents.

EXAMPLE.

Suppose a plank or board to be 15 inches wide and 27 feet long. The contents are required.

Extend from 1 foot, to 1 foot 3 inches, (or 1,25;) that

extent will reach from 27 feet to 33,75 = the superficial contents. Or, you may extend from 12 inches 15, &c.

The solid contents of any Bale, Box, Chest. &c. is found by extending from 1 to the breadth, that extent will reach from the depth to a fourth number; and the extent from 1 to that fourth number, will reach from the length to the solid contents.

EXAMPLES.

1. What is the solid contents of a square pillar, whose length is 21 feet 9 inches, breadth 1 foot 3 inches?

The extent from 1 to 1,25 will reach from 1,25 the depth, to 1,56, = the contents of 1 foot in length. Again, the extent from 1 to 1,56, will reach from the length = 21,75, to 33,9 or 34, nearly = the solid contents in feet.

2. Suppose a square piece of timber 1,25 foot wide, and 0,56 foot deep, and 36 feet long, be given, to find the solid contents.

Extend from 1 to 7; that extent will reach from 36 to 25,2 = the solid contents. In like manner may the contents of Bales be found, which divided by 40, will give the tonnage.

4. The Line of Sines, (marked SIN) corresponding to the Logarithmick Sines of the degrees of the Quadrant begins at the left hand, and is numbered towards the right; thus, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, then 20, 30, 40, &c. ending at 90°, where is a brass centre pin, as there is at the right hand of the lines.

5. The Line of Versed Sines, (marked VS) corresponding to the Log. Versed Sines of the degrees of the Quadrant, begins at the right hand against 90° on the sine; and from thence is numbered towards the left hand; thus, 10, 20, 30, and 40, &c. ending at the left hand, at about 169°. Each of the subdivisions from 10 to 30 is, in general two degrees; from thence to 90, is single degrees; from thence to the end, each degree is divided into 15 minutes.

6. The line of Tangents, (marked TANG) corresponding to the Log. Tangents of the degrees of the Quadrant, begins at the left hand, and is numbered towards the right; thus, 1, 2, 3, 4, and so on to 10, 20, 30, 40 and 45, where is a brass pin under 90° on the Sines; from thence it is numbered backwards 50, 60, 70, 80, &c. to 89, ending at the left hand

where it begins at 1 degree. The subdivisions are nearly similar to those of the Sines. When you have any extent in your dividers to be set off from any number less than 45° on the line of Tangents towards the right, and it is found to reach beyond the mark of 45°, you must see how far it extends beyond that mark, and set it off towards the left, and mark what degree it falls upon; which will be the number sought, and must exceed 45°. If, on the contrary, you are to set off such a distance to the right, from a number greater than 45°, you must proceed as before, only remember, that the answer will be less than 45°, and you must always consider the degrees above 45°, as if they were marked on the continuation of the line to the right hand of 45°.

7. The line of the Meridional parts, (marked MER,) begin at the right hand, and is numbered thus, 10, 20, 30, to the left hand, where it ends at 87°

8. This line, with the line of equal parts, (marked EP) under it, are used together, and only in Mercator's sailing. The upper line contains the degrees of the meridian, or latitude in Mercator's Chart, corresponding to the degrees of longitude on the lower line. The use of this scale in solving the usual Problems of Trigonometry, plain sailing, middle latitude sailing, and Mercator's sailing, will be given in the course of this work; but it will be unnecessary to enter into an explanation of its use in calculating the common Problems of Nautical Astronomy, it is more accurate to perform by Logarithms.

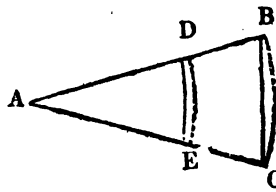
DESCRIPTION AND USE OF THE SECTOR.

This instrument consists of two rules or legs, representing the radius, moveable round an axis or joint, the middle of which, represents the centre, from whence several scales are drawn on the faces; some of the scales are single, others double. The single scales are like those on a common Gunter's scale; the double scales are those that proceed from the centre; each of these being laid twice on the same face of the instrument viz. once on each leg. From these scales dimensions or distances are to be taken

when the legs of the instrument are set in an angular position. The single scales being used exactly like Gunter's scale, I shall proceed to enumerate a few of the uses of the double scales, the number of which is seven; viz. the scale of lines, (marked LIN or L.) The scales of chords, (marked CHO or C.) The scale of sines, (marked SIN or S.) The scale of tangents, to 45° and another scale of tangents, from 45° to about 76° both of which are marked TAN or T. The scale of secants, (marked SEC or S.) And the scale of polygons, (marked POL.) The scale of lines, chords, sines and tangents, under 45° are all of the same radius, beginning at the centre of the instrument, and terminating near the other extremity of each leg, viz. the lines at the division 10; the chord at 60°; the sine at 90°; and the tangents at 45°. The remainder of the tangents, or those above 45° are other scales, beginning at a quarter of the length of the former, counting from the centre, where they are marked with 45°, and extend to about 76°. The secants also begin at the same distance from the centre, where they are marked with 0, and are thence continued to 75 deg. The scales of polygons are set near the inner edge of the legs, and where these scales begin, they are marked 4; and from thence are numbered backwards, on towards the centre 12. In describing the use of the Sector, the terms Lateral Distance, and Transverse Distance, often occur.

By the former is meant the distance taken with the compasses on one of the scales only, beginning at the centre of the sector. By the latter is meant the distance taken between any two corresponding divisions of the scales of the same name, the legs of the sector being in an angular position. The use of the sector depends upon the proportionability of the corresponding sides of similar triangles; demonstrated in Art. 53 Geometry. For, if in the triangle ABC we take AB=AC and AD=AE, and draw DE and BC, it is evident that DE and BC, will be parallel.—Therefore, by the above mentioned proposition AB:BC :: AD:DE; so, whatsoever part AD is of AB, the same part DE will be of BC; hence if DE be the chord, sine or tangent of any arch to the radius AD, so BC will be the same to the radius AB.

The line, of lines, is useful to divide a given line in-



to any number of equal parts, or in any proportion, or to find the 3d and 4th proportionals, or to increase a given line in any proportion.

EXAMPLES.

1. To divide a given line into any number of equal parts, as, suppose 9. Make the length of the given line, a transverse distance to 9, and 9 the number of parts proposed; then will the transverse distance of 1 and 1, be one of the parts, or $\frac{1}{9}$ part of the whole; and the transverse distance of 2 and 2, will be two of the equal parts, or $\frac{2}{9}$ of the whole line, &c.

2. If a man should travel 52 miles in 8 hours, how far would he travel in 3 hours at the same rate?

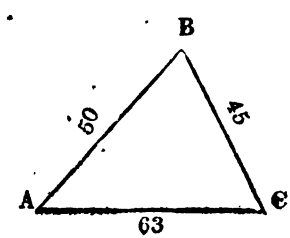
Take 52 in your compasses as a transverse distance, and set off from 8 to 8, then the transverse distance 3 and 3, being measured laterally, will be found equal to $19\frac{1}{2}$, which is the number of miles required.

3. Having a chart, constructed upon a scale of 6 miles to an inch, it is required to open the sector, so that a corresponding scale may be taken from the line of sines.—Make the transverse distance 6 and 6, equal to the lateral distance 3 and 3; then set off any distance from the chart laterally, and the corresponding transverse distance, will be the reduced distance required.

4 One side of any triangle being given of any length; to measure the other two sides, on the same scale.

Suppose the side AB, of the triangle ABC, measure 50, what are the measures of the other two sides?

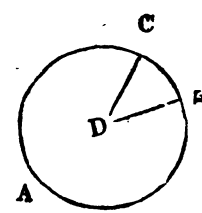
See fig. Take AB in your dividers, apply it transversely to 50 and 50, to this opening of the sector, apply the distance AC in your compasses to the same number on both sides of the rule, transversely; and where the two points fall, will be the measure on the line of lines,



the distance required; the distance AC, will fall against 63 and 63, and BC against 45 and 45 on the line of lines.

The line of chords on the sector is very useful for protracting any angle, when the paper is so small, that an arch cannot be drawn upon it with the radius of a common line of chords. Suppose it was required to set off an arch of 30°, from the point C, of the small circle ABC; take the radius in your compasses, and set it off transversely, from 60° to 60° on the line of chords. Then take the transeverse extent from 30° to 30° on the chords; and place one foot of the compasses at C, the other will reach to E and CE will be the arch required. By the converse operation, any angle or arch, may be measured; with any radius describe an arch about the angular point: set that radius transversely from 60° to 60°. Then take the distance of the arch, intercepted between the two legs, and apply it transversely to the chords, and it will shew the degrees of the given angle.

Note. When the angle to be protracted exceeds 60°, you must lay off 60°; and then the remaining parts; or if it be above 120°, lay off 60° twice; and then the remaining parts.—In this way any arch above 60° may be measured.



USE OF THE LINES OF SINES, TANGENTS AND SECANTS.

By the several lines disposed on the sector, we have scales of several radii. So that,

1. Having a length or radius given, not exceeding the length of the sector when opened, we can find the chord, sine, &c. of the same. Thus, suppose a chord, sine or tangent of 20°, to a radius of 2 inches be required. Make 2 inches the transverse opening to 60° and 60° on the chords; then will the same extent reach from 45° to 45°

on the tangents, and from 90° to 90° on the sines, so that to whatever radius the line of chords is set, to the same are all the others set also. In this disposition, therefore, if the transverse distance between 20° and 20° on the chords be taken with the compasses, it will give the chord of 20°; and if the transverse of 20° and 20°, be in like manner taken on the sines, it will be the sine of 20°; and lastly if the transverse distance of 20° and 20° be taken on the tangents, it will be the tangent of 20°, to the same radius of 2 inches.

2. If the chord, or tangent of 70° were required; for the chord you must first set off the chord of 60°; or the radius upon the arch, and then set off the chord of 10°, to find the tangent of 70°, to the same radius the scale of upper tangents must be used; the under one only reaching to 45°, making, therefore, two inches, the transverse distance 45°, and 45° at the beginning of the scale, the extent between 70°, and 70° on the same, will be the tangent of 70°, to 2 inches radius.

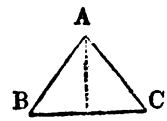
3. To find the secant of any arch; make the given radius the transverse distance between 0, and 0 on the secants; then will the transverse distance of 20° and 20°, or 70° and 70°, give the secant of 20° or 70° respectively.

4. If the radius, and any line representing a sine, tangent or secant, be given; the degrees corresponding to that line, may be found by setting the sector to the given radius, according as a sine, tangent or secant is concerned; then taking the given line between the compasses, and applying the two feet transversely to the proper scale, and sliding the feet along till they both rest on, like divisions on both legs, then the divisions will shew the degrees, and parts corresponding to the given line.

USE OF THE LINE OF POLYGONS.

The use of this line is to inscribe a regular polygon in a circle. For example; let it be required to inscribe an octagon in a circle. Open the sector, till the transverse distance, 6 and 6 be equal to the radius of the circle; then will the transverse distance of 8 and 8, be the side of the inscribed octagon, or polygon.

USE OF THE SECTOR IN TRIGONOMETRY.



All proportions in Trigonometry are easily wrought by the double lines on the sector; observing that the sides of triangles are taken off the line of lines, and the angles are taken off the sines, tangents or secants, according to the nature of the proportion. Thus, if the triangle ABC, we have given AB = 56, AC = 64, and the angle ABC = 46° 30′ to the rest in this case. We have (by art, 58 geometry) the following proportion; as AC (64) sine of the B (46° 30′) : : AB (56) : to the sine of the angle C, and as the sine B : is to the side AC : : so is the sine A : to the side BC; therefore to work these proportions by the sector, take the lateral distance 64 = AC from the line of lines, and open the sector to make this a transverse distance of 46° 30′ = angle B on the sines; then take the lateral distance 56 = AB on the line of lines, and apply it transversely on the sines, which will give 39° 24′ = to C; hence the sum of the angles B and C is 58° 54′ which taken from 180°, leaves the angle A = 94° 6′, then to work the secant proportion, the sector being set at the same opening as before, take the transeverse distance of 94° 6′ = the angle A on the sines, or which is the same thing, the transeverse distance of its supplement 85° 54′; then this applied laterally to the lines, gives the side sought BC = 88. In the same manner we might solve any problem in trigonometry, with the tangents and secants, instead of measuring them on the sines, as in the preceeding example.

All the problems that occur in nautical astronomy, may be solved by the sector; but the calculations by logarithms are much more accurate.

THE SLIDING RULE

Consists of a fixed part and a slider, and is of the same dimensions as a common Gunter's scale; and has the same

lines marked on the fixed part, as that scale has, and also on the plain scale; and these lines may be used with a pair of compasses, in the same manner, as the lines of those scales.

As a description of those lines, has already been given, it will be unnecessary to repeat it here: It being sufficient to observe, that there are two lines of numbers, viz: a line of Logarithmick sines, and a line of Logarithmick tangents on the slider. And the slider may be shifted, so as to fix either face of it on either side of the fixed part of the scale, according to the nature of the question to be solved.

In solving any problem in Arithmetick, Trigonometry, plain sailing &c. let the proportion be so stated, that the first and third terms may be alike, and of course, the second and fourth terms will be alike. Then bring the first term of the analogy on the fixed part, against the second term on the slider; and against the third term on the fixed part, will be found the fourth term on the slider. Or if necessary, the first and third terms may be found on the slider, and the second and fourth on the fixed part. Multiplication and Division are performed by this rule or method; only consider unity as one of the terms of the analogy.

MULTIPLICATION BY THE SLIDING RULE.

To perform multiplication, set 1 on the line of numbers of the fixed part, against one of the factors on the line of numbers on the slider; then against the other factor on the fixed part will be found the product on the slider.

Note. If the first and second terms are alike, or of one name, instead of the first and third, you must bring the first term on the slider, against the third on the fixed part, and against the second term on the slider, will be found the fourth term on the fixed part; or if necessary the first and second terms may be found on the fixed part, and the third and fourth on the slider.

EXAMPLES.

1. To find the product of 5, by 12. Draw out the slider, till 1 on the fixed part, coincides with 5 on the slider; then opposite 12 on the fixed part, will be found 60=the product, on the slider.

2. To find the product of 50, by 12. Not moving the slider, count 5 to be 50; count 12 as before; then opposite 12 on the fixed part, will be found 600 on the slider.

3. Place the slider as before, count 5 to be 500, and 12 to be 1200; the answer, 600,000; will be found on the slider.

4. To find the product of 17 by 25. Draw out the slider till 1 on the fixed part, coincides with 17 on the slider, then opposite 25 on the fixed part, will be found 425 on the slider.

5. To find the product of 17 by 17. Draw out the slider, till 1 on the fixed part coincides with 17 on the slider, then opposite 17 on the fixed part, will be found 289 on the slider.

6. Place the slider the same as before; against 50 on the fixed part will be found 850 on the slider.

7. The slider laying at 17 as before, count 50 or 5 to be opposite 500 on the fixed part, will be found 8500 on the slider.

8. Place the slider as before, count 17 to be 1700, count 3 to be 300 on the fixed part, then opposite 300 on the fixed part will be found 510,000 on the slider.

9 To find the product of $21\frac{1}{2}$ by 20. Draw out the slider till the centre 1 on the fixed part coincides with $21\frac{1}{2}$ on the slider, then opposite 20 on the fixed part will be found 430 on the slider.

10 To find the product of 5 by $2\frac{1}{2}$ count the first 1 on the fixed part, to be $\frac{1}{10}$, the centre one count 1, draw out the slider till 1 on the fixed part coincides with 5 on the slider, opposite $2\frac{1}{2}$ on the fixed part will be found $12\frac{1}{2}$ on the slider.

DIVISION BY THE SLIDING RULE.

Place the divisor on the line of numbers of the fixed part against 1 on the slider, then against the dividend found on the fixed part, will be found the quotient on the slider.

EXAMPLES

1 To divide 60 by 5. Set 5 on the fixed part against 1 on the slider, then against 60 on the fixed part, will be found 12=the quotient on the slider.

2. To divide 400 by 27. Set 27 on the fixed part against 1 on the slider, then against 400 on the fixed part, will be found $14\frac{2}{27}$ or about $14\frac{1}{3}$ on the slider.

3. To answer several questions, not moving the slider in in one lesson, the slider placed as in Example 2.

Divisors.	Dividends.	Quotients.
27	–:– 400	$14\frac{2}{27}$ or $14\frac{1}{3}$
27	–:– 500	$18\frac{14}{27}$ or $18\frac{1}{2}$
27	–:– 600	$22\frac{2}{9}$ or $22\frac{1}{4}$
27	–:– 700	$25\frac{25}{27}$ or 26 nearly
27	–:– 800	$29\frac{17}{27}$ or $29\frac{2}{3}$
27	–:– 850	$31\frac{13}{27}$ or $31\frac{1}{2}$
27	–:– 900	$33\frac{1}{3}$
27	–:– 1000	$37\frac{1}{27}$ or 37

You will have gone the length of the fixed part to A, on the statement.

4. To divide any number from 700 to 6000 that is at B on the slider, the full of the extent of the slider. From the statement, draw out the slider on A, to the left hand of the centre 1, to the figure 6, representing 60 on the fixed part, over 1 on the slider; then against 7 representing 700, on the fixed part, will be found $11\frac{2}{3}$ on the slider. Now, not moving the slider, you may find this lesson from 700 to 6000.

Divisors.	Dividends.	Quotients.
60	–:– 700	$11\frac{2}{3}$
60	–:– 800	$13\frac{1}{3}$
60	–:– 900	15
60	–:– 1000	$16\frac{2}{3}$
60	–:– 2000	$33\frac{1}{3}$ Ending at
60	–:– 3000	50 B, at the
60	–:– 4000	$66\frac{2}{3}$ right hand
60	–:– 5000	$83\frac{1}{3}$ of the sli-
60	–:– 6000	100 der.

EXAMPLES IN THE RULE OF THREE BY THE SLIDING RULE.

If 3 lbs. of beef cost 21 cents, what will, from 30 to 100 lbs. cost?

This lesson reaches from 30 to 70 different statements, viz. from 30 to 100, not moving the slider ; bring 3 on the letter A, of the fixed part, on the line of numbers against 21 on the line marked B, on the slider ; then against 30 on the fixed part on A, will be found on the slider, $2,10 ; and against 35 lbs. will be 2,45 ; 40—2,80 ; 50—3,50, 60—4,20 ; 75—5,25 ; 90—6,30 ; 100—7,00.

2. If $4\frac{1}{2}$ yds. cost $23, what will 20 yds. cost ?

RULE.

Draw out the slider, till $23 coincides with $4\frac{1}{2}$ on the fixed part ; then against 20 on the fixed part, will be found $102, on the slider. Now not moving the slider, at A, on the fixed part, 100 yds. will be found to the answer on the slider = $5,11.

3. If 4 lbs. of sugar cost $1,50, what will 20 lbs. cost ?

Bring 4 on the line of numbers on the fixed part, against $1,50 on the line of numbers on the slider ; then against 20 on the line of numbers, on the fixed part, will be found $7,50 on the slider. Now not moving the slider, against 40, on A, will be found $15,00 on the slider. Again, not moving the slider, against 80, on A, will be found $30,00 ; and at A, 100 lbs on the slider, B will be found $37,50—ABCD on the right of the rule.

4. To find the circumference of a circle, whose diameter shall be 20.

RULE.

Draw out the slider, till 22 on the slider coincides with 7 on the fixed part, then against 20 on the fixed part, will be found $62\frac{6}{7}$ or $62\frac{3}{4}$ on the slider. Again, not moving the slider, against 25 on the fixed part, will be found $78\frac{4}{7}$ on the slider. Again, not moving the slider, against 40 on the fixed part, will be found $125\frac{5}{7}$ on the slider. Again, not moving the slider, against 60 on the fixed part, will be found $188\frac{4}{7}$ on the slider. Now, not moving the slider, against 100 at A, on the fixed part, will be found $314\frac{2}{7}$ on the slider.

5. If one yard of cloth cost $9,00, what will $\frac{5}{16}$ of a yard cost ?

Draw out the slider, till 9 on the slider coincides with 16 on the fixed part, then against 5 on the fixed part, will be found on the slider $2,83.

BOARD MEASURE BY THE SLIDING RULE.

EXAMPLES.

1. To measure a board 12 feet long, and 12 inches wide: 12 on the fixed part, to the right of the centre 1 counts 12 feet in length; but 12 on the slider give 12 to 12, or 12 feet.

2. A board 12 feet long, and 19 inches wide.

Draw out the slider, till 19 coincides with 12 on the fixed part, that makes the board 19 feet=the answer on the slider; 19 inches the answer in feet.

3. A board 14 feet long and 20 inches wide.

Draw out the slider till 20 coincides with 12 on the fixed part, then against 14 on the fixed part, the answer 23$\frac{1}{3}$ ft.

4. A board 22 feet long, 20 inches wide.

Draw out the slider till 20 inches coincides with 12 on the fixed part, and against 22 on the fixed part, will be found the answer 36$\frac{2}{4}$ feet on the slider.

5. A board table that extends from 4 to 100 feet in length, and 36 inches wide.

Draw out the slider, till 36 coincides with 12 on the fixed part; count the 1st 1 on the fixed part 10; begin at 4 on the fixed part 4, so on to 10 at the centre, and so on to 100 on the right hand, to A. Begin on the slider at 4, and reckon at different lengths.

Fixed part.	Slider.	Fixed part.	Slider.
4	12	33$\frac{1}{3}$	100
5	15	40	120
6	18	50	150
7	21	55	165
8	24	60	180
10	30	66$\frac{2}{3}$	200
12	36	70	210
15	45	75	225
20	60	80	240
25	75	90	270
30	90	100	300

6. A log 14 feet long cuts 27 boards, each board 36 inches wide, how many feet in one board ?

Ans, 42 feet.

How many feet in the 27 boards ?

Draw the slider till 27 coincides with the centre 1, against 42 on the fixed part, will be the answer on the slider=to 1134.

A log 12 feet long, 24 inches in diameter, cuts 15 boards, 20 inches broad.

Draw out the slider, till 20 is against 12 ; 20 will be the answer for one board. Draw out the slider till 15 comes against the centre 1 on the fixed part, and against 20 on the fixed part will be found 300 on the slider=the answer in board measure.

A log 2 feet in diameter, and under ; 2 inches on each side are allowed for slab, and $\frac{1}{5}$ for saw calf, and 1 board for wane : and from 24 to 36 inches diameter, 3 inches for slab, $\frac{1}{5}$ for saw calf, and 2 boards for wane.

A log 28 inches at the small end, will cut 18 boards, only 16 measured.

Draw out the slider till 22=the breadth of the board, comes against 12, and against 14=the length on the fixed part, will be found the answer on the slider for one board $=25\frac{3}{4}$. Now draw out the slider till 16, the number of boards, comes against the centre 1 : now to find the rest, say the log was 14 feet long, your answer on the slider is 414 feet nearly.

Again, a log 14 feet long, 36 inches at the small end slab-bed, leaves the board 30 inches wide, $\frac{1}{5}$ for sawcalf, leaves 24 and 2 wane leaves 22. Draw out the slider till 30 comes against 12 on the fixed part, and under 14 on the fixed part, will be found 35 on the slider. Then draw out the slider till 22 comes against the centre 1, and against 35 will be found 770 on the slider, which will be the answer for a log 36 inches in diameter, and 14 feet long.

A log 20 inches at the small end, and 16 feet long, cuts 13 boards that are 16 inches wide, and but 12 measured, how many feet ? Ans. 255

A log 16 inches in diameter, 14 feet long, cuts 9 boards, and but 8 measured, how many feet ? Answer 112 feet on the slider.

TO MEASURE SQUARE TIMBER IN SOLID FEET BY THE SLIDING RULE.

RULE.

Draw out the slider to the left hand, till the length of the timber found on the slider, shall correspond to 12 on the girt line; then against the inches, the stick is square on the girt line, will be found the number of cubic feet on the slider.

EXAMPLE. To measure a stick of timber 60 feet long, and from 5 to 40 inches square.

Draw the slider to the left hand, till 6 on the slider (which call 60,) corresponds with 12 on the girt line, and against 5 on the slider, will be found $10\frac{42}{100}$ on the girt line. The same answer can be found by drawing the slider to to the right, but the divisions are not so easily distinguished, without more practice.

By letting the slider remain, you may solve all the questions proposed above in a short time, and will put their answers in a table for exercise.

Inches sqr.	Cubic feet in the stick.	Inches sqr.	Cubic feet in the stick.	Inches sqr.	Cubic feet in the stick.
5	10,42	14	82	23	220
6	15	$14\frac{1}{2}$	88	$23\frac{1}{2}$	$231\frac{1}{4}$
7	20,42	15	94	24	242
$7\frac{1}{2}$	$23\frac{1}{2}$	$15\frac{1}{2}$	$100\frac{1}{2}$	$24\frac{1}{2}$	250
8	$26\frac{1}{2}$	16	$106\frac{1}{2}$	25	260
$8\frac{1}{2}$	$30\frac{1}{10}$	17	$120\frac{1}{2}$	26	$282\frac{1}{2}$
9	$33\frac{1}{2}$	18	135	27	303
$9\frac{1}{2}$	$37\frac{2}{3}$	$18\frac{1}{2}$	142	28	327
10	$41\frac{2}{3}$	19	150	29	352
$10\frac{1}{2}$	46	$19\frac{1}{2}$	$158\frac{1}{2}$	30	375
11	50,42	20	$166\frac{2}{3}$	31	402
$11\frac{1}{2}$	55	$20\frac{2}{4}$	$174\frac{2}{4}$	32	426
12	60	$20\frac{3}{4}$	180	35	510
$12\frac{2}{4}$	$65\frac{1}{5}$	21	$184\frac{2}{4}$	38	602
13	$70\frac{2}{4}$	22	202	40	667 nearly.

In this table the timber is all 60 feet.

TO MEASURE HEWN TIMBER THAT IS NOT SQUARE, BY THE SLIDNG RULE.

EXAMPLES.

1. To find the solid feet in a stick of timber, 50 feet in length, and 7 by 10 inches.

Draw out the slider, till 50 coincides with 12 on the girt line, and against the thickness, 7 inches, found on the girt line you will find 17 on the slider, which is the answer, at 7 inches square. There will then remain 3 times 7=21 inches, and 50 feet long, yet to find; to obtain which, draw the slider to the right, till 21 on the slider coincides with 12 on the line marked A; then against, 50, the length found on A, you will find 87½ on the slider; this must be divided by 12 and it will give 7 feet 3½, inches or 7¼, which being added to the 17, before found, gives 24¼ feet, contained in the stick.

2. To find the solid feet in a stick 45 feet long, 27 inches wide, and 22 inches thick.

Draw out the slider, till 45 on the slider coincides with 12 on the girt line, then over 22, found on the girt line, will be 151½ on the slider, which gives the dimensions of a stick 45 feet long and 22 inches square. Now 5×22 remain=110, which number find on the slider, and let it coincide with 12 on A; then against 45 on A, you will find 413 on the slider; this divided by 12 gives 34⅓ which added to 151½ before found, gives 186 nearly, for the answer.

3. To find the solid feet in a stick of timber, 60 feet long, 30 inches wide and 14 inches thick.

Draw out the slider, till 60 on the slider, coincides with 12 on the girt line, then over 14 on the girt line, you will find 81⅓ on the slider; now by doubling this, will give the contents, equal to 28 by 14, and the 2 left is 2 by 14, which is ⅐ of 14; divide 81⅓=11⅔; then add 81⅔ 81⅔ 11⅔=175 the answer. Or find the avarage square=20,5. Then find 20,5 on the girt line, and directly over it on the slider will be 175; observing to draw out the slider, till the length of the stick in feet coincides with 12 on the girt line.

4. To find the solid feet of a stick of timber, 55 feet long, 25 inches wide and 20 thick.

Draw out the slider, till 55 coincides with 12 as before; then over 20, found on the girt line, will be 153 nearly; this divided by 4, and the quotient added gives 191¼ feet the answer. Or for the 5 inches left, say 5 times 20 is= 100; the square root of which is 10: now look on the slider over 10, will be found 38¼ as before.

A little practice will render the performance easy and expeditious.

Where it is practicable, cast it into a square; as 9 by 4, multiplied, gives 36, the square root of which is=6 the answer. Or cast the log into board measure, by drawing the slider against 30, the width, on the slider under 12 on the fixed part A; then under 60, the length on the fixed part, you will find 150 on the slider,=number of square feet in one board; then lay 14, the width on the slider, under 1 on the fixed part, then against 150 on the fixed part, will give 2100 feet of boards on the slider; now divide by 12 by drawing 1 on the slider, against 12 on the fixed part, then against 2100 on the fixed part will be found 175 on the slider, the answer in cubic feet.

GUAGING OF ROUND TIMBER, OR TAKING A GUAGE POINT, AND CASTING INTO CUBIC FEET.

RULE. Let your guage point, found on the girt line be 13,54 inches; now to find the contents of a stick or log, bring the length of the timber, found on the slider, to coincide with the above guage point; then the diameter in inches or parts, found on the girt line, will coincide with the number of cubic feet on the slider.

EXAMPLE. Suppose a stick of timber 12 feet long, and 15 inches in diameter; how many cubic feet?

Against 15 inches, will be found 15 feet,
" 20 " " " 26¾ "
" 30 " " " 59 "
" 35 " " " 80,8 "

MENSURATION.

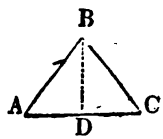
PROBLEM I.

To find the Area of a Triangle.

Multiply the base by half the perpendicular; or multiply half the base by the whole perpendicular, and the product will be the area required.

EXAMPLE. Given AC, the base = 30 feet, and the perpnedicular BD = 20.

30 = base.	15 = half base.
10 = half perp.	20 = perp.
300 = area.	300 = area.



PROBLEM II.

*To find the Area of a Circle.**

Square the diameter of the circle, and multiply that square by the decimal ,7854, which decimal, is as much less than unity or 1, as the inscribed circle is to its superscribing square. Or which is nearly the same, multiply the square by 11 and divide by 14.

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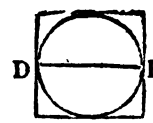
* The circumference of any circle may be found, by multiplying the diameter by 22 and dividing that product by 7, or multiplying the diameter by 355 and dividing by 113, which numbers may be easily remembered, by observing, that the two numbers being set together, thus, 113,355 make a double series of odd numbers viz. 11, 33 and 55. The circumference of any circle being given, the diameter may be found, by reversing the above rule. Thus, multiply the circumference by 7 and divide by 22, or better, multiply by 113 and divide by 355. Or you may divide the circumference by 3,1416, or to find the circumference, multiply the diameter by 3,1416.

EXAMPLE. A circle whose diameter DB = 10,6.

10,6		112,36 = square.	
10,6		11	
636		14) 1235,96 (88,282	
106		112	
112,36 = sqare.		115	
,7854		112	
44944		39	
56180		28	
89888			
78652		116	
		112	
88,247544 = area.			
		40	



PROBLEM III.

To find the Area of an Ellipsis, or Oval..

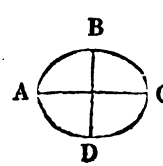
Multiply the longest or transverse diameter, by the shortest or conjugate diameter, and this product by ,7854, and the last product will be the area.

EXAMPLE. Suppose the transvesre AC = 12 and the conjugate BD = 10

12
10

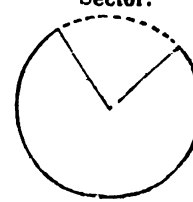
120
,7854

94,2480 area



Definition. A sector of a circle is a part of a circle bounded by two radii, or semidiameters, and by an arch of the primitive circle whose area may be found by means of the whole area of the whole circle: Thus, as 360 degrees, is to angle or degrees between the two legs or radii of the sector, so is the area of the whole circle, to the area of the sector.

Sector.



area.

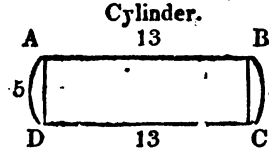
EXAMPLE. As 360° : 288° : : 314,16 : 251,328° the Ans.

PROBLEM IV.

To find the Solidity of a Cylinder.

Multiply the square of the diameter of either end or base by ,7854 which will give the area of the base; then multiply this area by the length and it will give the solidity required.

Cylinder.



EXAMPLE. AD or BC = 5

5

25 = square of the diameter of

,7854 the base or end.

160

125

200

175

19,6350 = area of the base or end.

13

58905

19635

25,5255 = solidity of the cylinder in feet.

PROBLEM V.

To find the Solidity of a Grindstone.

Grindstones in the form of cylinders, are sold by the stone of 24 inches diameter and 4 inches thick: Now, to know how many such stones are contained in a given cylinder, multiply the square of the diameter, in inches, by the thickness, in inches, and divide the product by 2304 and you will have the number required.

EXAMPLE

How many stones of 24 inches diameter and 4 thick, are contained in a stone of 36 inches diameter and 8 inches thick?

36 inches diameter.
36

216
108

1296 = square.
8 = thickness.

2304) 10368 (4,5 Ans. = 4 1-2 stones.
9216

11520
11520

This problem may be solved very expeditiously, by means of the line of numbers on Gunter's scale, by the following rule. Extend from 48 to the diameter: continue that extent three times its length, from the thickness, and it will reach to the number of stones required So in the foregoing example, extend from 48 to 36 the diameter: continue that esten} three times its length, from the thickness, which is 8 inches, and it will reach to 4,5 or 4 1-2 the answer.

PROBLEM VI.

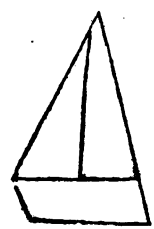
To find the Solidity of a Pyramid or Cone.

First find the area of the base, whether square, triangular or circular, or any other form, by the proper rule for each; then multiply this area by one third the perpendicular height, and it will give the solidity required.

EXAEPLES.

1. What is the solidity of a pyramid which has a square base, whose side is 4 feet, and perpendicular hight 6 feet.

1st.



4
4

16 = area
2 = ⅓ height,

32 = solidity.

2. What is the solidity of a cone whose base is 10,6 feet, and perpendicular height is 30 feet.

2d.

10,6 = diameter of the base
10,6

112,36 = square.
,7854

88,247544 = area.
10 = ⅓ height. = 30

882,475440 = solidity.

This solidity divided by 40, will give the number of tons in that cone.

40) 882,47544|0

22,061886 = tons

PROBLEM VII.

To find the Tonnage of a Ship.

By a law of Congress of the United States of America, the tonnage of a ship is to be found in the following manner.

"If the vessel be double decked, take the length thereof, from the fore part of the main stern to the after part of the stern post above the upper deck; the breadth thereof, to be taken at the broadest part above the main wale, half of which breadth, shall be accounted the depth of such vessel; then deduct from the length three fifths of the breadth, then multiply the remainder by the breadth and this product by the depth, divide this last product by ninety-five, and the quotient will be the true contents or tonnage of such vessel. If the vessel be single decked, take the length and breadth, as above directed, in a double decked vessel; and deduct from the length, three fifths of the breadth; and taking the depth from the under side of the deck plank to the ceiling in the hold; then multiply and divide as above directed, and the quotient will be the true contents or tonnage of such vessel."

EXAMPLE. If the length of a double decked vessel, be 80 feet, and the breadth 24 feet, what is her tonnage?

80 ft. length
14,4, $\frac{3}{5}$ the breadth.

65,6
24 breadth.

2624
1312

1574,4
12 depth, or $\frac{1}{2}$ the breadth.

18892,8 to be divided by 95.

95) 18892,8 (198,871 Ans.
95

939
855

842
760

828
760

680
665

150

Note. Ship carpenters, in finding the tonnage, multiply the length of the keel, by the breadth of the main beam, and the depth of the hold in feet, and then divide the product by 95; the quotient is the number of tons. In double decked vessels, half the breadth is taken for the depth

GUAGING OF CASKS.

Having found the number of cubic inches in any body, by the preceding rules, you may from thence, determine their contents, in gallons, bushels, &c. by dividing that number of cubic inches, by the number of cubic inches in a gallon, bushel, &c. respectively. A wine gallon, by which most liquors are measured, contains 231 cubic inches. A beer, ale, or milk gallon, contains 282 cubic inches. A bushel of corn, malt, &c. contains 2150,4 cubic inches. This measure is subdivided into 8 gallons; each of which contains 268,8 cubic inches. In all the following rules, it supposes the dimensions of a cask or vessel, to be given in inches, and decimal parts of an inch.

PROBLEM I.

To find the number of Gallons or Bushels in a Vessel of a Cubic Form.

Divide the cube of one of the sides in inches by 231, and it gives wine gallons, divide the same cube by 282 and it gives beer gallons; and divide by 2150,4 and it gives the number of bushels the vessel will hold.

EXAMPLE. Required the number of wine and beer gallons, also the bushels contained in a cubic box or cistern whose side is 50 inches.

50
50

2500
50

231) 125000 (541,1 gallons, wine measure.
1155

950
924

260
231

290
230

59

282) 125000 (443,26 gallons, beer measure.
1128

1220
1128

920
846

740
564

1760

2150,4) 125000,0 (58,1 bushels.
107520

174800
172032

27680

PROBLEM II.

To find the number of Gallons or Bushels contained in a body of a Cylindrical Form.

Multiply the square of the diameter of either end or base, by the length of the cylinder, and divide the product by 294,12 and the quotient will be the number of wine gallons divide the same number by 359,05 the quotient will be the number of beer or ale gallons; and divide the product by 2738 and the quotient will be the number of bushels.

Note. The above numbers for divisors are found by dividing 231, 282 and 2150,4, by the decimal ,7854.

EXAMPLE. Required the number of wine gallons, in the cylinder delineated in the figure of problem 4, of mensuration. The diameter of its base, being 5 feet = 60 inches, and the length 13 feet = 156 inches.

60	294,12) 561600,00 (1909,48 Ans.	
60	29412	
3600	267480	
156	264708	
21600	277200	
18000	264708	
3600	124920	
561600 dividend.	117648	
	72720	

Here observe, that two cyphers are affixed to the product to equal the number of decimals in the divisor, which makes the quotient the number of gallons; but the other cyphers added to the remainder, gives decimals.

PROBLEM III.

To find the number of Gallons or Bushels contained in a body of the form, of a Pyramid or Cone. See figure in Problem 6, of Mensuration.

Multiply the area of the base of the pyramid or cone, by one third of its perpendicular height; the product divided by 231 will give the answer in wine gallons; divide by 282 it will give the answer in beer gallons; and divide by 2150,4 and it will give the answer in bushels.

EXAMPLE. Required the number of beer gallons, contained in a pyramid, whose base is 30 inches square, and perpendicular height is 60 inches?

30 inches, side of the
30 square base.

900
20 ½ the height

Inches in a beer gal. 282) 18000 (63,8 Ans.
1692

1080
846

2340
2256

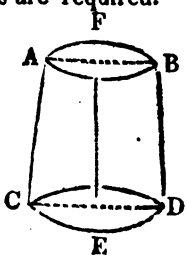
84

PROBLEM IV.

To find the number of Gallons or Bushels contained in a Vessel in the form of a Frustum of a Cone.

Multiply the top and bottom diameters together, and to the product add one third of the square of the difference of the same diameters, then multiply this sum by the perpendicular height, and divide the product by 292,12 for wine gallons; by 359,05 for beer gallons; and by 2738 for bushels.

EXAMPLE. Given the diameter DC = 40 inches; the diameter AB = 30 inches, and the perpendicular height FE = 60 inches; the contents in wine gallons are required.



40 bottom diameter
30 top diameter

10 difference
10

3) 100 sqr. of the difference

33,3 = ⅓ the square

30 top diameter
40 bottom diameter

1200
33,3

1233,3
60 perpendicular height

294,12) 73998,00 (251,59 gallons, wine measure.
58824

161740
147060

46800
29412

173880
147060

268200

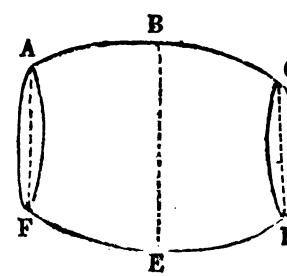
PROBLEM V.

To Guage a Cask.

To guage a cask, measure the head diameters FA and DC, and if they differ, take the mean of them, that is, add the diameters of each head together and divide the sum by 2; measure also the diameter EB at the bung, taking the measure, inside of the cask; then measure the length of the cask, making due allowance for the thickness of the heads: Having these measures, you can calculate the contents in gallons or bushels, by the following rule:

Take the difference between the head and bung diameters, multiply this difference by ,62 and add the product to the head diameter, the sum will be the mean diameter; multiply the square of this by the length of the cask, and divide the product by 294,12 for wine, by 359,05 for beer gallons, and by 2738 for bushels. The decimal ,62 is commonly used by guagers, to find the mean diameter; but if the staves are nearly straight, it would be more accurate to use ,55 or less. If on the contrary, they are very curving we should use ,64, ,65, or more. When the staves are straight, the decimal ,51 may be used.

EXAMPLE. Given the bung diameter BE 34,5 inches, the head diameter AF or CD=30,7, after allowing for the thicknes of the heads; 59,3 inches the length, find the number of wine gallons this cask will hold.



34,5 bung diameter.
30,7 head do.

3,8.
,62

76
228

2,356
30,7 head diameter.

33,056 mean do.
33,056

198336
165280
99168
99168

1092,699136 call the decim. 67
1092,67
59,3 length on the inside.

327801
983403
546335

294,12) 64795,331 (220,3 Ans.
58824

59713
58824

88931
88236

695

Calipers are used by guagers, in taking the dimensions of casks, but a common rule, or a staff may be used. A more

expeditious way of finding the contents of casks, is by the line of numbers on Gunter's scale ; or on the sliding rule ; in order to perform which, make marks on the scale, on the calipers, at the points 17,15 and 18,95 inches and at 52,33 inches, which numbers are the square roots of 294,-12, and 359,05, and of 2738 respectively. A brass pin is generally fixed on the calipers at each of these points, which are called the guage points. Having prepared the scales in this manner, you may calculate the number of gallons or bushels, by the following rule :

Extend from 1 towards the left hand to ,62, or less, if the staves be nearly straight ; that extent will reach from the difference between the head and bung diameters, to a number at the left hand, which number added to the head diameter, will give the mean diameter ; then put one foot of the compasses on the guage point=17,15, for wine gallons, 18,95, for beer gallons, and at 52,33, for bushels ; and extend the other foot of the compasses to a number denoting the mean diameter ; this extent turned over twice the same way from the length of the cask, will give the number of gallons or bushels respectively.

In the preceding example, the extent from 1 to ,62 will reach from 3,8 to 2,4, nearly, which added to 30,7 gives the mean diameter=33,1, then the extent from the guage point, 17,15 to 33,1 turned over twice from the length 59,-3, will reach to 220,9, wine gallons. If you had used the guage point 18,95 the answer would have been in beer gallons ; or if you had used 52,33 the answer would have been in bushels.

GUAGING CASKS BY THE SLIDING RULE.

On the line marked D, you may find the guage point, marked WG ; you will see that you can find 17,15 inches, a little to the right of the long mark, that is over the centre of G ; also over AG on the same scale you will find 18,-95, or $18\frac{14}{16}$, very near the long mark over the centre of G, here is the guage point for the ale or beer gallons, as the other was for wine gallons. Set the length of the cask found on the slider, against the guage point on D ; and a-

gainst the mean diameter on D, the answer will be found on the slider.

In measuring the length of a cask, we allow for the thickness of both heads, 1 inch, $1\frac{1}{2}$ or 2 inches, according to the size of the cask.

Note. You must take the head diameter, close to its outside, and for small casks add $\frac{2}{10}$ inch, for casks of 30, 40, or 50 gallons, add $\frac{4}{10}$ inch, and for larger casks add 5 or 6 tenths and the sum will be very near the head diameter within.

In taking the bung diameter, observe in moving the rod or staff backward and forward, to see if the staves opposite the bung, be thicker or thinner than the rest, if so, make the necessary allowance.

EXAMPLE. Given the bung diameter BE= 34,5 inches, the head diameter AF, or CD= 30,7 inches.

Length of the cask within= 59,3.

34,5
30,7
2) 65,2
32,6
,5
33,1= mean diameter.

Now draw out the slider, till 59,3 on the slider, coincides with the guage point on the girt line, for wine gallons, and against 33,1 on the girt line, will be found on the slider =220,9 wine gallons.

PROBLEM VI.

The guage point for bushels is placed on the girt line, at 13,$\frac{385}{1000}$ *inches, as it would run off the rule on the right.— For the points for gallons, reverse it back to the left of those points.*

Draw out the slider, till the length of a square box or bin, coincides with the guage point on the girt line, to wit against $13\frac{385}{1000}$ inches, then against the number of inches

the box is square, found on the girt line; and on the slider will be found the number of bushels.

EXAMPLES.

1. Given 7,75 inches square and 30 feet in length, also beginning at 7,75, and extend to 40 inches square.

Against 7,75, will be found 10 bushels.

"	9	"	"	13½	" nearly.
"	10	"	"	16⅔	"
"	12	"	"	24	"
"	13,40	"	"	30	"
"	15	"	"	37½	"
"	17	"	"	48¼	"
"	19	"	"	60	"
"	20	"	"	66⅔	"
"	21	"	"	73½	"
"	24,5	"	"	100	" nearly.
"	25	"	"	104⅔	"
"	27	"	"	121½	"
"	29	"	"	140½	"
"	30	"	"	150	"
"	35	"	"	208	"
"	40	"	"	267½	"

When the bin is more than 40 inches, say 60 inches, and 20 feet long, draw the slider to the left hand till 20 feet, the length found on the slider, coincides with the guage point found on the girt line, to wit, 13,385 inches; then against the width of the bin, namely 60 inches, which found on the girt line, will be found on the slider 399, calling the figures on the girt line tens, and those on the slider will be hundreds; and so of any other number.

2. Suppose a bin 30 feet long, and from 40 to 245 inches square.

Against 40 will be found 267 bushels.

"	60	"	"	598½	"
"	100	"	"	1675	"
"	120	"	"	2500	"
"	150	"	"	3790	"
"	190	"	"	6000	"
"	245	"	"	9950	"

To find how many bushels any cylindrical cask will contain ; or how many bushels of timber any log will contain, providing it be a complete cylinder.

Draw the slider, till the guage point, 15,001, or nearer, 15,0015, found on the girt line, coincides with the length of the cylinder in feet, found on the slider ; then against the diameter of the cylinder, found on the girt line in inches, will be the number of bushels found on the slider.

EXAMPLE. Suppose the cylinder 300 feet laid to the guage point, then against 7, or 70 inches for a diameter, you will find 6444 bushels, the answer on the slider.

TO CUT OFF ANY NUMBER OF CUBIC FEET OF ANY DIAMETER, OF ROUND TIMBER.

Suppose the number of feet required to be cut off, be 3, and the diameter be 7¼ inches.

Draw out the slider till 3 coincides with 7¼ on the fixed part, then against the guage point 13,54 inches will be found the length to be cut off.

EXAMPLES.

1. If $2,15 buy 1 foot of timber how much will $10 buy ? 4,65 cubic feet, Ans.

2. This timber is 4,3 inches in diameter ; what is the length of the stick ?

Lay 4,65 feet on the slider, against 4,3 inches, on the girt line, and against 13,54 inches on the girt line will be found 46,5 feet, the length of the stick on the slider.

For square timber, draw the slider so that the number of inches the stick is square, found on the fixed part, coincides with the number of feet on the slider ; then against 12 will be found the number of feet in length to be cut off.

TO CAST INTEREST ON THE SLIDING RULE FOR ONE YEAR.

Let the principal or number of dollars be found on A, and put the per cent on the slider against the centre 1 ; then against the principal, will be found the interest, calling dollars, cents. To cast interest for days, find the days for

one year or 365, on the fixed part A ; then draw the slider till the interest for one year before found, coincide with the 365 days ; now, on the fixed part A, notice the number of days you want to get the interest for, and under that on the slider, will be found the interest for the days required.

EXAMPLES.

1 What is the interest $333,33 for one year and twenty-five days, at 6 per cent. First for one year, by the above directions, will be found $20 ; now notice 365 days on A, and draw the slider till $20 coincides with it or under 365 days, then look for 25 days on A, and on B, under 25 will be $1,33⅓ the answer for 25 days.

2 What is the interest of $1000 for one year and thirty-six days at 7 per cent. Draw out the slider till 7 on the slider coincides with the centre 1 and against 1000 on the right hand at A, will be found 70 on the slider. Then lay 70 on the slider against 365 days on the fixed part and against 36 on the slider will be found $6,88 Ans. $76,88.

A Table, for the use of Coopers, in calculating Cisterns.

Wine gallons and parts of gallons.	¼ 555	½ 590	¾ 665	1 725	1 810	1 890	2 977	2 1080	2 1175	3 1285	3 1387	3 1548	4 1742	4 1892	4 1827	5 2143	5 2345	6 2622
Smallest head in feet and inches.	00	02	04	06	08	10	00	02	04	06	08	10	00	02	00	01	06	07
Largest head in feet and inches.	06	08	10	00	02	04	06	08	10	00	02	06	10	06	06	03	06	07
Depth of the cistern in feet and inches.	5 00	5 02	5 04	5 06	5 08	5 10	6 00	6 02	6 04	6 06	6 08	6 10	7 00	7 03	7 06	7 09	8 00	8 03

A LOG TABLE,

Shewing the number of feet of boards, any log will make, whose diameter, is from 15 *to* 36 *inches at the smallest end, and from* 10 *to* 15 *feet in length.*

Diameter in Inches.	10 Feet in length.	Diameter in Inches.	11 Feet in length.	Diameter in Inches.	12 Feet in length.	Diameter in Inches.	13 Feet in length.	Diameter in Inches.	14 Feet in length.	Diameter in Inches.	15 Feet in length.
15	90	15	99	15	108	15	117	15	126	15	135
16	100	16	110	16	120	16	130	16	140	16	150
17	125	17	137	17	150	17	160	17	175	17	187
18	155	18	170	18	186	18	201	18	216	18	232
19	165	19	176	19	198	19	214	19	230	19	247
20	172	20	189	20	206	20	263	20	246	20	258
21	184	21	202	21	220	21	238	21	256	21	276
22	194	22	212	22	232	22	263	22	294	22	291
23	219	23	240	23	278	23	315	23	332	23	333
24	250	24	276	24	300	24	325	24	350	24	375
25	280	25	308	25	336	25	364	25	392	25	420
26	299	26	323	26	346	26	375	26	404	26	448
27	327	27	367	27	392	27	425	27	457	27	490
28	360	28	396	28	432	28	462	28	504	28	540
29	376	29	414	29	451	29	488	29	526	29	564
30	412	30	452	30	494	30	535	30	576	30	618
31	428	31	471	31	513	31	558	31	602	31	642
32	451	32	496	32	541	32	587	32	631	32	676
33	490	33	539	33	588	33	637	33	686	33	735
34	532	34	585	34	638	34	691	34	744	34	798
35	582	35	640	35	698	35	752	35	805	35	863
36	593	36	657	36	717	36	821	36	836	36	889

A Table of Specific Gravities of Bodies.

Platina (pure)	23000	Clay	2160
Fine Gold	19400	Brick	2000
Standard Gold	17724	Common Earth	1984
Quicksilver (pure	14000	Nitre	1900
Quicksilver (common)	13600	Ivory	1825
Lead	11325	Brimstone	1810
Fine Silver	11091	Solid Gunpowder	1745
Standard Silver	10535	Sand	1520
Copper	9000	Coal	1250
Copper halfpence	8915	Box-wood	1030
Gun Metal	8784	Sea-water	1030
Cast Brass	8000	Common-water	1000
Steel	7850	Oak	925
Iron	7645	Gunpowder, close shaken	937
Cast Iron	7425	Ditto. in a loose heap	836
Tin	7320	Ash	836
Clear Crystal Glass	3150	Maple	755
Granite	3000	Elm	600
Marble and hard stone	2700	Fir	550
Common green Glass	2600	Charcoal	
Flint	2570	Cork	240
Common Stone	2520	Air at a mean state	$1\frac{2}{9}$

Note. The several sorts of wood are supposed to be dry. Also, as a cubic foot of water weighs just 1000 ounces avoirdupois, the numbers in this table express, not only the specific gravities of the several bodies, but also the weight of a cubic foot of each, in avoirdupois ounces; and therefore, by proportion, the weight of any other quantity, or the quantity of any other weight, may be known, as in the next two propositions.

PROPOSITION I.

To find the Magnitude of any Body, from its Weight.

As the tabular specific gravity of the body,
Is to its weight in avoirdupois ounces,
So is one cubic foot, or 1728 cubic inches,
To its contents in feet, or inches, respectively.

EXAMPLES.

1. Required the contents of an irregular block of common stone, which weighs 1 cwt. or 112 lb?
Ans. $1228\frac{20}{25}\frac{16}{20}$ cubic inches.

2. How many cubic inches of gunpowder are there in 1 lb. weight? Ans. $29\frac{1}{2}$ cubic inches nearly.

3. How many cubic feet are there in a ton weight of dry oak? Ans. $38\frac{13}{18}\frac{8}{5}$ cubic feet.

PROPOSITION II.

To find the Weight of a Body from its Magnitude.

As one cubic foot, or 1728 cubic inches,
Is to the contents of the body,
So is the tabular specific gravity,
To the weight of the body.

EXAMPLES.

1. Required the weight of a block of marble, whose length is 63 feet, and breadth and thickness each 12 feet; being the dimensions of one of the stones in the walls of Balbeck?
Ans. $683\frac{4}{5}$ ton, which is nearly equal to the burden of an East-India ship.

2. What is the weight of 1 pint ale measure, of gunpowder? Ans. 19 oz. nearly.

3. What is the weight of a block of dry oak, which measures 10 feet in length, 3 feet broad, $1\frac{1}{2}$ feet deep or thick? Ans. $4335\frac{15}{16}$ lb.

A TABLE OF SOLID MEASURE OF SQUARE TIMBER,

By the following Table the solid contents, and the value of any piece or quantity of timber stone &c. may be found at sight, from 6 inches to $29\frac{1}{2}$ inches, the side of the square, or one fourth of the girt; and from 14 feet to 92 feet in length. It rises from 6 inches, $\frac{1}{2}$ inch at a time till it rises to $29\frac{1}{2}$ inches, and from 14 feet, 1 foot at a time till it rises

to 92 feet. The number of inches which the side of each stick measures are placed at the top of the two first or left hand columns, and at the top of the two columns at the right hand of each double line. These columns give the length and contents of each stick, and the other two columns which run from the top to the bottom of the page are a continuation of the two first; so the length of the stick will be found in the first and third column from the left hand of the page, and from the right hand of each double line; and in the second and fourth columns the contents. The half feet are not reckoned; that is, when a stick measures, for example, 30 cubic feet and 5 inches it is reckoned only 30 feet, and if it measures 30 cubic feet and 7 inches it is reckoned 31 feet, &c. this is the method of reckoning timber in Quebec and Montreal, and in all markets in the United States.

Side 6	51	13	Side 6½	51	15	Side 7	51	17	Side 7½	51	20
Ft. long.	Ins.		Ft. long.	Ins.		Ft. long.	Ins.		Ft. long.	Ins.	
	Cont.	52 13		Conts.	52 15		Conts.	52 17		Conts.	52 20
		53 13			53 16			53 18			53 20
		54 13			54 16			54 18			54 21
		55 14			55 16			55 18			55 21
14	3	56 14	14	4	56 16	14	5	56 19	14	5	56 22
15	4	57 14	15	4	57 17	15	5	57 19	15	6	57 22
16	4	58 14	16	5	58 17	16	5	58 19	16	6	58 22
17	4	59 15	17	5	59 17	17	6	59 20	17	6	59 23
18	4	60 15	18	5	60 18	18	6	60 20	18	7	60 23
19	5	61 15	19	6	61 18	19	6	61 20	19	7	61 24
20	5	62 15	20	6	62 18	20	7	62 21	20	8	62 24
21	5	63 16	21	6	63 18	21	7	63 21	21	8	63 24
22	5	64 16	22	6	64 19	22	7	64 21	22	8	64 25
23	6	65 16	23	7	65 19	23	8	65 22	23	9	65 25
24	6	66 16	24	7	66 19	24	8	66 22	24	9	66 26
25	6	67 17	25	7	67 20	25	8	67 22	25	10	67 26
26	6	68 17	26	8	68 20	26	9	68 23	26	10	68 26
27	7	69 17	27	8	69 20	27	9	69 23	27	10	69 27
28	7	70 17	28	8	70 21	28	9	70 23	28	11	70 27
29	7	71 18	29	9	71 21	29	10	71 24	29	11	71 27
30	7	72 18	30	9	72 21	30	10	72 24	30	11	72 28
31	8	73 18	31	9	73 21	31	10	73 25	31	12	73 28
32	8	74 18	32	9	77 22	32	11	74 25	32	12	74 29
33	8	75 19	33	10	75 22	33	11	75 25	33	13	75 29
34	8	76 19	34	10	76 22	34	11	76 26	34	13	76 29
35	9	77 19	35	10	77 23	35	12	77 26	35	13	77 30
36	9	78 19	36	11	78 23	36	12	78 26	36	14	78 30
37	9	69 20	37	11	79 23	37	12	79 27	37	14	79 31
38	9	80 20	38	11	80 23	38	13	80 27	38	15	80 31
39	10	81 20	39	11	81 24	39	13	81 27	39	15	81 31
40	10	82 20	40	12	82 24	40	13	82 28	40	15	82 32
41	10	83 21	41	12	83 24	41	14	83 28	41	16	83 32
42	10	84 21	42	12	84 25	42	14	84 28	42	16	84 33
43	11	85 21	43	13	85 25	43	14	85 29	43	17	85 33
44	11	86 21	44	13	86 25	44	15	86 29	44	17	86 34
45	11	87 22	45	13	87 25	45	15	87 39	45	17	87 34
46	11	88 22	46	13	88 26	46	15	88 30	46	18	88 34
47	12	79 22	47	14	89 26	47	16	89 30	47	18	89 35
48	12	90 22	48	14	90 26	48	16	90 30	48	19	90 35
49	12	91 23	49	14	91 27	49	16	91 31	49	19	91 35
50	12	92 23	50	15	92 27	50	17	92 31	50	19	92 36

Side 8 Ins.		51	22	Side 8½ Ins.		51	25	Side 9 Ins.		51	28	Side 9½ Ins.		51	32
		52	23			52	26			52	29			52	32
		53	23			53	26			53	30			53	33
		54	24			54	27			54	31			54	34
		55	24			55	27			55	31			55	34
Ft. long.	Cents.			Ft. long.	Cents.			Ft. long.	Cents.			Ft. long.	Cents.		
14	6	56	25	14	7	56	28	14	8	56	32	14	9	56	35
15	6	57	25	15	7	57	28	15	8	57	32	15	9	57	36
16	7	58	26	16	8	58	29	16	9	58	33	16	10	58	36
17	7	59	26	17	8	59	29	17	9	59	33	17	10	59	37
18	8	60	26	18	9	60	30	18	10	60	34	18	11	60	37
19	8	61	27	19	9	61	30	19	10	61	34	19	12	61	38
20	9	62	27	20	10	62	31	20	11	62	35	20	12	62	39
21	9	63	28	21	10	63	31	21	12	63	35	21	13	63	39
22	10	64	28	22	11	64	32	22	12	64	36	22	14	64	40
23	10	65	29	23	11	65	32	23	13	65	36	23	14	65	41
24	10	66	29	24	12	66	33	24	13	66	37	24	15	66	41
25	11	67	30	25	12	66	33	25	14	67	37	25	15	67	42
26	11	68	30	26	13	68	34	26	14	68	38	26	16	68	42
27	12	69	30	27	13	69	34	27	15	69	39	27	17	69	43
28	12	70	31	28	14	70	35	28	16	70	39	28	18	70	44
29	13	71	31	29	14	71	35	29	16	71	40	29	18	71	44
30	13	72	32	30	15	72	36	30	17	72	40	30	19	72	45
31	14	73	32	21	15	73	36	31	17	73	41	31	19	73	46
32	14	74	33	32	16	74	37	32	18	74	41	32	20	74	46
33	14	75	33	33	16	75	37	33	18	75	42	33	20	75	47
34	15	76	34	34	17	76	38	34	19	76	43	34	21	76	47
35	15	77	34	35	17	77	38	35	19	77	44	35	22	77	48
36	16	78	34	36	18	78	39	36	20	78	44	36	23	78	49
37	16	79	35	37	18	79	39	37	21	79	45	37	23	79	49
38	17	80	35	38	19	80	40	38	21	80	45	38	24	80	50
39	17	81	36	39	19	81	41	39	22	81	45	39	24	81	51
40	18	82	36	40	20	82	41	40	22	82	46	40	25	82	51
41	18	83	37	41	21	83	42	41	23	83	47	41	25	83	52
42	18	84	37	42	21	84	42	42	23	84	47	42	26	84	52
43	19	85	38	43	21	85	43	43	24	85	48	43	27	85	53
44	19	86	38	44	22	86	43	44	25	86	48	44	27	86	54
45	20	87	38	45	22	87	44	45	25	87	49	45	28	87	54
46	20	88	39	46	23	88	44	46	26	88	49	46	29	88	55
47	21	89	39	47	23	89	44	47	26	89	50	47	29	89	55
48	21	90	40	48	24	90	45	48	27	90	51	48	30	90	56
49	22	91	40	49	24	91	46	49	27	91	51	49	30	91	57
50	22	92	41	50	25	92	46	50	28	92	52	50	31	92	58

Side 10 Ins.	51	35	Side 10½ Ins.	51	39	Side 11 Ins.	51	43	Side 11½ Ins.	51	47
	52	36		52	40		52	43		52	48
Ft. long.	53	37	Ft. long.	53	41	Ft. long.	53	44	Ft. long.	63	49
	54	37		54	42		54	45		54	50
	55	38		55	42		55	46		55	51
	Contents.			Contents.			Contents.			Contents.	
14	9 56	39	14	10 56	43	14	12 56	47	14	13 56	52
15	10 57	39	15	11 57	44	15	12 57	48	15	14 57	52
16	11 58	40	16	12 58	44	16	13 58	49	16	14 58	54
17	12 59	41	17	13 59	45	17	14 59	49	17	15 59	55
18	13 60	41	18	14 60	46	18	15 60	50	18	16 60	56
19	14 61	42	19	14 61	47	19	16 61	51	19	17 61	56
20	15 62	43	20	15 62	47	20	17 62	52	20	18 62	58
21	15 63	44	21	16 63	48	21	17 63	53	21	19 63	59
22	16 64	44	22	17 64	50	22	18 64	54	22	20 64	59
23	16 65	45	23	17 65	50	23	19 65	54	23	21 65	60
24	17 66	46	24	18 66	51	24	20 66	55	24	22 66	61
25	17 67	46	25	19 67	52	25	21 67	56	25	23 67	62
26	18 68	47	26	20 68	52	26	22 68	57	26	24 68	62
27	19 69	48	27	20 69	53	27	22 69	58	27	25 69	63
28	20 70	48	28	21 70	54	28	23 70	59	28	25 70	64
29	20 71	49	29	22 71	54	29	24 71	59	39	26 71	65
30	21 72	50	30	23 72	55	30	25 72	60	30	27 72	66
31	21 73	50	31	23 73	56	31	26 73	61	31	28 73	67
32	22 74	51	32	24 74	57	32	27 74	62	32	29 74	68
33	33 75	52	33	25 75	57	33	27 75	63	33	30 75	69
34	24 76	53	34	26 76	58	34	28 66	64	34	31 76	70
35	24 77	53	35	27 77	59	35	29 74	64	25	32 77	71
36	25 78	54	36	27 78	59	36	30 78	65	36	39 78	71
37	26 79	55	37	28 79	60	37	31 79	66	37	34 79	72
38	27 80	55	38	29 80	61	38	32 80	67	38	35 80	73
39	27 81	56	39	30 81	62	39	33 81	68	39	36 81	74
40	28 82	57	40	30 82	63	40	33 82	69	40	36 82	75
41	29 83	57	41	31 83	63	41	34 83	70	41	37 83	76
42	29 84	58	42	32 84	64	43	35 84	70	42	38 84	77
43	30 85	59	43	33 85	65	43	36 85	71	43	39 85	78
44	30 86	60	44	34 86	66	44	37 86	72	44	40 86	69
45	31 87	60	25	35 87	67	45	38 87	73	45	41 87	80
46	32 88	61	46	35 88	67	46	38 88	74	46	42 88	80
47	33 89	62	47	36 89	68	47	39 89	75	47	43 89	81
48	33 90	62	48	37 90	69	48	40 90	75	48	44 90	82
49	34 91	63	49	38 91	70	49	41 91	76	49	45 91	83
50	34 92	64	50	38 92	71	50	42 92	77	50	46 92	84

Side 12 Ins.	51	51	Side 12½ Ins.	51	55	Side 13 Ins.	51	60	Side 13½ Ins.	51	64
Ft. long.	52	52	Ft. long.	52	56	Ft. long.	52	61	Ft. long.	52	66
	53	53		53	57		53	62		53	67
Conts.	54	54	Conts.	54	58	Conts.	54	63	Conts.	54	68
	55	55		55	59		55	64		55	69
14	14 56	56	14	15 56	60	14	16 56	66	14	17 56	71
15	15 57	57	15	16 57	62	15	17 57	67	15	19 57	72
16	16 58	58	16	17 58	63	16	19 58	68	16	20 58	73
17	17 59	59	17	18 59	64	17	20 59	69	17	21 59	74
18	18 60	60	18	19 60	65	18	21 60	70	18	23 60	76
19	19 61	61	19	21 61	66	19	22 61	71	19	24 61	77
20	20 62	62	20	22 62	67	20	23 62	73	20	25 62	78
21	21 63	63	21	23 63	68	21	25 63	74	21	26 63	79
22	22 64	64	22	24 64	69	22	26 64	75	22	28 64	81
23	23 65	65	23	25 65	71	23	27 65	76	23	29 65	82
24	24 66	66	24	26 66	72	24	58 66	77	24	30 66	83
25	25 67	97	25	27 67	73	25	29 67	78	25	31 67	35
26	26 68	68	26	28 68	74	26	30 68	80	26	33 68	86
27	27 69	69	27	29 69	75	27	32 69	81	27	34 69	87
28	28 70	70	28	30 70	76	28	33 70	82	28	35 70	88
29	29 71	71	29	31 71	77	29	34 71	83	29	36 71	90
30	30 72	72	30	33 72	78	30	35 72	84	30	38 72	91
31	31 73	73	31	34 73	79	31	36 73	85	31	39 73	62
32	32 74	74	32	35 74	80	32	38 74	87	32	40 74	93
33	33 75	75	33	36 75	81	33	39 75	88	33	42 75	95
34	34 76	76	34	37 76	82	34	40 76	89	34	43 76	96
35	35 77	77	35	38 77	83	35	41 77	90	35	44 67	97
36	36 78	78	36	39 78	84	36	42 78	91	36	45 78	98
37	37 79	79	37	40 79	86	37	43 79	92	37	47 79	100
38	38 80	80	38	41 80	87	38	44 80	94	38	48 80	101
39	39 81	81	39	42 81	88	39	46 81	95	39	49 81	102
40	40 82	82	40	43 82	89	40	47 82	96	40	50 82	103
41	41 83	83	41	44 83	90	41	48 83	97	41	52 83	105
42	42 84	84	42	45 84	91	42	49 84	99	42	53 84	106
43	43 85	85	43	46 85	92	43	50 85	100	43	54 85	107
44	44 86	86	44	48 86	93	44	51 86	101	44	55 86	109
45	45 87	87	45	49 87	94	45	53 87	102	45	57 87	110
46	46 88	88	46	50 88	95	46	54 88	103	46	58 88	111
47	47 89	89	47	51 89	96	47	55 89	104	47	59 89	112
48	48 90	90	48	52 90	97	48	56 90	105	48	60 90	114
49	49 91	91	49	53 91	98	49	57 91	106	49	62 91	115
50	50 92	92	50	54 92	100	50	58 92	108	50	63 92	116

Side 14 Ins.	51	69	Side 14½ Ins.	51	74	Side 15 Ins.	51	79	Side 15½ Ins.	51	85
Ft. long.	52	71	Ft. long.	52	76	Ft. long.	52	81	Ft. long.	52	87
	53	72		53	77		53	82		53	88
	54	73		54	79		54	84		54	90
	55	75		55	80		55	86		55	92
Conts.			Conts.			Conts.			Conts.		
14 19	56	76	14 20	56	82	14 22	56	87	14 23	56	93
15 20	57	77	15 22	57	83	15 23	57	89	15 25	57	95
16 22	58	79	16 23	58	84	16 25	58	90	16 26	58	97
17 23	59	80	17 25	59	86	17 26	59	92	17 28	59	98
18 24	60	81	18 26	60	87	18 28	60	94	18 30	60	100
19 26	61	83	19 27	61	89	19 29	61	95	19 31	61	102
20 27	62	84	20 29	62	90	20 31	62	97	20 33	62	103
21 28	63	86	21 30	63	92	21 33	63	98	21 35	63	105
22 30	64	87	22 32	64	93	22 34	64	100	22 36	64	106
23 31	65	88	23 33	65	95	23 36	65	101	23 38	65	108
24 32	66	90	24 35	66	96	24 37	66	103	24 40	66	110
25 34	67	91	25 36	67	98	25 39	67	105	25 41	67	112
26 35	68	92	26 38	68	99	26 40	68	106	26 43	68	113
27 37	69	94	27 39	69	101	27 42	69	108	27 45	69	115
28 38	70	95	28 41	70	102	28 44	70	109	28 46	70	117
29 39	71	96	29 42	71	103	29 45	71	111	29 48	71	118
30 41	72	98	30 44	72	105	30 47	72	112	30 50	72	120
31 42	73	99	31 45	73	106	31 48	73	114	31 51	73	122
32 43	74	100	32 46	74	108	32 50	74	115	32 53	74	124
33 45	75	102	33 48	75	109	33 51	75	117	33 55	75	125
24 46	76	103	34 49	76	111	34 53	76	119	34 56	76	127
35 47	77	104	35 51	77	112	35 54	77	120	35 58	77	128
36 49	78	106	36 52	78	114	36 56	78	122	36 60	78	130
37 50	79	107	37 54	79	115	37 58	79	123	37 61	79	132
38 51	80	108	38 55	80	117	38 59	80	125	38 63	80	133
39 53	81	110	39 57	81	118	39 61	81	126	39 65	81	135
40 54	82	111	40 58	82	119	40 62	82	128	40 66	82	136
41 55	83	113	41 60	83	121	41 64	83	129	41 68	83	138
42 57	84	114	42 61	84	122	42 65	84	131	42 70	84	140
43 58	85	116	43 63	85	124	43 67	85	133	43 71	85	142
44 60	86	117	44 64	86	126	44 69	86	134	44 73	86	143
45 61	87	118	45 65	87	127	45 70	87	136	45 75	87	145
46 62	88	120	46 67	88	128	46 72	88	138	46 76	88	147
47 64	89	121	47 68	89	130	47 73	89	139	47 78	89	148
48 65	90	122	48 70	90	131	48 75	90	140	48 80	90	150
49 66	91	124	49 71	91	133	49 76	91	142	49 82	91	152
50 68	92	125	50 73	92	134	50 78	92	144	50 83	92	153

Side 16 Ins.	51	90	Side 16½ Ins.	51	96	Side 17 Ins.	51	102	Side 17½ Ins.	51	108
Ft. long.	Conts.	52 92	Ft. long.	52 98		Ft. long.	52 104		Ft. long.	52 110	
		53 94		53 100			53 106			53 112	
		54 96		54 102			54 108			54 115	
14	25	55 98	14	26 55	104	14	28 55	110	14	30 55	117
15	26	56 99	15	28 56	106	15	30 56	112	15	32 56	119
16	28	57 101	16	30 57	108	16	32 57	114	16	34 57	121
17	30	58 103	17	32 58	109	17	34 58	116	17	36 58	123
18	32	59 105	18	34 59	111	18	36 59	118	18	38 59	125
19	34	60 106	19	36 60	113	19	38 60	120	19	40 60	127
20	35	61 108	20	38 61	115	20	40 61	122	20	42 61	129
21	37	62 110	21	39 62	117	21	42 62	124	21	44 62	132
22	39	63 112	22	41 63	119	22	44 63	126	22	47 63	135
23	41	64 114	23	43 64	121	23	46 64	128	23	49 64	136
24	42	65 115	24	45 65	123	24	48 65	130	24	51 65	138
25	44	66 117	25	47 66	125	25	50 66	132	25	53 66	140
26	46	67 119	26	49 67	126	26	52 67	134	26	55 67	142
27	48	68 121	27	51 68	128	27	54 68	136	27	57 68	44
28	50	69 122	28	53 69	130	28	56 69	38	27	60 69	146
29	51	70 124	29	55 70	132	29	58 70	140	29	62 70	149
30	53	71 126	30	56 71	134	30	60 71	142	30	64 71	151
31	55	72 128	31	58 72	36	31	62 72	144	31	66 72	153
32	57	73 130	32	60 73	138	32	64 73	146	32	68 73	155
33	58	74 131	33	62 74	140	33	66 74	148	33	70 74	157
34	60	75 133	34	64 75	142	34	68 75	150	34	72 75	159
35	62	76 135	35	66 76	143	35	70 76	152	35	74 76	161
36	64	77 137	36	68 77	145	36	72 77	154	36	77 77	164
37	66	78 138	37	70 78	147	37	74 78	156	37	78 78	166
38	67	79 140	38	72 79	149	38	76 79	158	38	81 79	168
39	69	80 142	39	73 80	151	39	78 80	160	39	83 80	170
40	71	81 144	40	65 81	153	40	80 81	162	40	85 81	172
41	73	82 146	41	77 82	155	41	32 82	164	41	87 82	174
42	74	85 147	42	79 83	157	42	84 83	166	42	89 83	176
43	76	84 149	43	81 84	159	43	86 84	168	43	91 84	178
44	78	85 151	44	83 85	161	44	88 85	170	45	93 85	181
45	80	86 153	45	85 86	163	45	90 86	172	45	95 86	183
46	82	87 154	46	87 87	164	46	92 87	175	46	98 87	185
47	83	88 156	47	89 88	166	47	94 88	176	47	100 88	187
48	85	89 158	48	91 89	168	48	96 89	177	48	102 89	189
49	87	90 160	49	92 90	170	49	98 90	189	49	104 90	191
50	89	92 162	50	94 91	172	50	100 91	182	51	106 91	193
		92 164		92	174		92	185		92	196

Side 18 Ins.		51	115
Ft. long.	Conts.	52	117
		53	119
		54	121
		55	124
14	31	56	126
15	34	57	128
16	36	58	130
17	38	59	133
18	40	60	135
19	43	61	137
20	45	62	139
21	47	63	142
22	49	64	144
23	52	65	146
24	54	66	148
25	56	67	151
26	58	68	153
27	61	69	155
28	63	70	157
29	65	71	160
30	67	72	162
31	70	73	164
32	72	74	166
33	74	75	169
34	76	76	171
35	79	77	173
36	81	78	175
37	83	79	178
38	85	80	180
39	88	81	182
40	90	82	184
41	92	83	187
42	94	84	189
43	97	85	191
44	99	86	93
45	101	87	196
46	103	88	198
47	106	89	200
48	108	90	202
49	110	91	205
50	112	92	206

Side 18½ Ins.		51	121
Ft. long.	Conts.	52	123
		53	126
		54	128
		55	130
14	33	56	133
15	35	57	136
16	38	58	138
17	40	59	140
18	43	60	142
19	45	61	145
20	47	62	147
21	50	63	150
22	52	64	152
23	54	65	154
24	57	66	157
25	59	67	159
26	62	68	161
27	64	69	164
28	66	70	166
29	69	71	169
30	71	72	171
31	73	73	173
32	76	74	176
33	78	75	178
34	81	76	180
35	83	77	183
36	85	78	185
37	88	79	188
38	90	80	190
39	92	81	192
40	95	82	195
41	97	83	197
42	100	84	199
43	102	85	202
44	104	86	204
45	107	87	207
46	109	88	209
47	111	89	211
48	114	90	214
49	116	91	216
50	119	92	219

Side 19 Ins.		51	128
Ft. long.	Conts.	52	130
		53	133
		54	135
		55	138
14	35	56	140
15	37	57	143
16	40	58	145
17	42	59	148
18	45	60	150
19	47	61	152
20	50	62	155
21	52	63	158
22	55	64	160
23	57	65	163
24	60	66	165
25	62	67	68
26	65	68	7
27	67	69	73
28	70	70	175
29	72	71	78
30	75	72	180
31	77	73	185
32	80	74	185
33	82	75	188
34	85	76	190
35	87	77	193
36	90	78	195
37	92	79	198
38	95	80	200
39	97	81	203
40	100	82	205
41	102	83	208
42	105	84	210
43	108	85	215
44	110	86	215
45	113	87	218
46	115	88	220
47	118	89	223
48	120	90	225
49	123	91	228
50	125	92	230

Side 19½ Ins.		51	134
Ft. long.	Conts.	52	137
		53	140
		54	142
		55	145
14	37	56	148
15	39	57	150
16	42	58	153
17	45	59	156
18	47	60	158
19	50	51	161
20	53	62	163
21	55	63	166
22	58	64	169
23	60	65	171
24	63	66	174
25	66	67	177
26	68	68	179
27	71	69	182
28	74	70	185
29	76	71	187
30	79	72	190
31	82	73	192
32	84	74	195
33	87	75	198
34	90	76	200
35	92	77	203
36	95	78	206
37	97	79	208
38	100	80	211
39	103	81	214
40	105	82	216
41	108	83	219
42	111	84	222
43	113	85	224
44	116	86	227
45	119	87	230
46	121	88	232
47	124	89	235
48	127	90	237
49	129	91	240
50	132	92	242

OF THE WEIGHT AND DIMENSIONS OF BALLS.

PROBLEM I.

To find the Weight of an Iron Ball, from its Diameter.

An iron ball of 4 inches diameter weighs 9lbs. and the weights being as the cubes of the diameters, it will be, as 64 (which is the cube of 4) is to 9 its weight, so is the cube of the diameter of any ball, to its weight. Or, take $\frac{9}{64}$ of the cube of the diameter, for the weight. Or, take $\frac{1}{7}$ of the cube of the diameter, and $\frac{1}{8}$ of that again, and add the two together, for the weight.

EXAMPLES.

1. The diameter of an iron shot being 6·7 inches, required its weight? Ans. 42·294lb.

2. What is the weight of an iron ball, whose diameter is 5·54 inches? Ans. 24lb. nearly.

PROBLEM II.

To find the Weight of a Leaden Ball.

A leaden ball of 1 inch diameter weighs $\frac{3}{14}$ of a pound; therefore as the cube of 1 is to $\frac{3}{14}$, or as 14 is to 3, so is the cube of the diameter of the leaden ball, to its weight.—Or, take $\frac{3}{14}$ of the cube of the diameter, for the weight, nearly.

EXAMPLES.

1. Required the weight of a leaden ball of 6·6 inches diameter? Ans. 61·606lb.

2. What is the weight of a leaden ball of 5·30 inches diameter? Ans. 32lb. nearly.

PROBLEM III.

To find the Diameter of an Irom Ball.

Multiply the weight by $7\frac{1}{5}$, and the cube root of the product will be the diameter.

EXAMPLE. What is the diameter of a 24lb. ball?
Ans. 5·54 inches.

PROBLEM IV.

To find the Diameter of a Leaden Ball.

Multiply the weight by 14, and divide the product by 3; then the cube root of the quotient will be the diameter.

EXAMPLE. What is the diameter of an 8lb leaden ball?
Ans. 3·343 inches.

A TABLE OF SOLID MEASURE, OF ROUND TIMBER.

By the following Table the solid contents of any stick of round timber may be found at sight, from 6 inches to 40 inches in diameter, and from 7 feet to 91 feet in length. It rises 1 inch in diameter at a time, and one foot in length at a time. The left hand columns of each page, and the columns at the right hand of each double line, give the inches in diameter, and the other columns the contents, which are given in cubic feet and tenths of a foot. Over the top of these two columns is placed the length of the stick; and to find the contents of any stick, first find the length at the top, then the inches in diameter in the left hand column, and against this, to the right hand, will be fonnd the contents sought for, in cubic feet and tenths of a foot. For example: to find the number of cubic feet, which a stick contains, that is 7 feet in length, and 10 inches in diameter—first find 7 feet at the top, then follow the left hand column down to 10; then against 10 to the right hand will be found 3 feet and 8 tenths of a foot.

Side 20	51	141	Side 20½	51	149	Side 21	51	156	Side 21½	51	163
Ft. long.	Ins. 52	144	Ft. long.	Ins. 52	152	Ft. long.	Ins. 52	159	Ft. long.	Ins. 52	167
	Conts. 53	147		Conts. 53	154		Conts. 53	162		Cont. 53	170
	54	150		54	157		54	165		54	173
	55	153		55	160		55	168		55	176
14	39	56 155	14	41	56 168	14	43	56 171	14	45	56 180
15	41	57 158	15	44	57 166	15	46	57 174	15	48	57 183
16	44	58 161	16	46	58 169	16	49	58 177	16	51	58 186
17	47	59 164	17	49	59 172	17	52	59 180	17	54	59 189
18	50	60 166	18	52	60 175	18	55	60 184	18	58	60 192
19	53	61 169	19	55	61 178	19	58	61 187	19	61	61 196
20	55	62 172	20	58	62 181	20	61	62 190	20	64	62 199
21	58	63 175	21	61	63 184	21	64	63 193	21	67	63 202
22	61	64 178	22	64	64 187	22	67	64 196	22	70	64 205
23	64	65 180	23	67	65 189	23	70	65 199	23	74	65 208
24	66	66 183	24	70	66 192	24	73	66 202	24	77	66 212
25	69	67 186	25	73	67 195	25	76	67 205	25	80	67 215
26	72	68 189	26	76	68 198	26	79	68 208	26	83	68 218
27	75	69 191	27	79	69 201	27	82	69 211	27	86	69 221
28	78	70 194	28	81	70 204	28	86	70 214	28	90	70 224
29	80	71 197	29	84	71 207	29	89	71 217	29	93	71 228
30	83	72 200	30	87	72 210	30	92	72 220	30	96	72 231
31	86	73 203	31	90	73 213	31	95	73 223	31	99	73 234
32	89	74 205	32	93	74 216	32	98	74 226	32	102	74 237
33	91	75 208	33	96	75 219	33	101	75 229	33	106	75 241
34	94	76 211	34	99	76 322	34	104	76 233	34	109	76 244
35	97	77 214	35	102	77 224	35	107	77 236	35	112	77 247
36	100	78 216	36	105	78 227	36	110	78 239	36	115	78 250
37	103	79 219	37	108	79 230	37	113	79 242	37	119	69 253
38	105	80 222	38	111	80 233	38	116	80 245	38	122	80 257
39	108	81 225	39	114	81 236	39	119	81 248	39	125	81 260
40	111	82 228	40	116	82 239	40	122	82 251	40	128	82 263
41	114	83 230	41	119	83 242	41	125	83 254	41	131	83 266
42	116	84 233	42	122	84 245	43	128	84 257	42	135	84 269
43	119	85 236	43	125	85 248	43	131	85 260	43	138	85 273
44	122	86 239	44	128	86 251	44	135	86 263	44	141	86 276
45	125	87 241	25	131	87 254	45	138	87 266	45	244	87 279
46	128	88 244	46	134	88 257	46	141	88 269	46	147	88 282
47	130	89 247	47	137	89 260	47	144	89 272	47	150	79 285
48	133	90 250	48	140	90 262	48	147	90 275	48	154	90 289
49	136	91 253	49	143	91 265	49	150	91 278	49	157	91 292
50	139	92 155	50	146	92 268	50	153	92 282	50	160	92 295

Side 22 Ins.	51	171	Side 22½ Ins.	51	179	Side 23 Ins.	51	187	Side 23½ Ins.	51	196
	52	175		52	183		52	191		52	199
	53	178		53	186		53	194		53	203
	54	181		54	190		54	198		54	207
	55	185		55	193		55	202		55	211
Ft. long.	Conts.		Ft. long.	Conts.		Ft. long.	Conts.		Ft. long.	Conts.	
14	47	56 188	14	49	56 197	14	51	56 205	14	53	56 215
15	50	57 191	15	52	57 200	15	55	57 209	15	57	57 219
16	54	58 195	16	56	58 204	16	59	58 213	16	61	58 222
17	57	59 198	17	60	59 207	17	62	59 217	17	65	59 226
18	60	60 202	18	63	60 211	18	66	60 220	18	69	60 230
19	64	61 205	19	67	61 214	19	70	61 224	19	73	61 234
20	67	62 208	20	70	62 218	20	73	62 228	20	76	62 238
21	70	63 212	21	74	63 221	21	77	63 231	21	80	63 241
22	74	64 215	22	77	64 225	22	81	64 235	22	84	64 245
23	77	65 218	23	81	65 228	23	84	65 239	23	88	65 249
24	80	66 222	24	84	66 232	24	88	66 242	24	92	66 253
25	84	67 225	25	88	67 235	25	92	67 246	25	96	67 257
26	87	68 228	26	91	68 239	26	95	68 250	26	99	68 261
27	91	69 232	27	95	69 243	27	99	69 253	27	103	69 264
28	94	70 235	28	98	70 246	28	103	70 257	28	107	70 268
29	97	71 238	29	102	71 249	29	106	71 261	29	111	71 272
30	101	72 242	30	105	72 253	30	110	72 264	30	115	72 276
31	104	73 245	31	109	73 256	31	114	73 268	31	119	73 280
32	107	74 248	32	112	77 260	32	117	74 272	32	122	74 284
33	111	75 252	33	116	75 263	33	121	75 275	33	126	75 287
34	114	76 255	34	119	76 267	34	125	76 279	34	130	76 291
35	117	77 259	35	123	77 270	35	128	77 283	35	134	77 295
36	121	78 262	36	126	78 274	36	132	78 286	36	138	78 299
37	124	79 265	37	130	79 277	37	136	79 290	37	142	79 303
38	127	80 269	38	133	80 281	38	139	80 294	38	145	80 307
39	131	81 272	39	137	81 285	39	143	81 297	39	149	81 310
40	134	82 275	40	140	82 288	40	147	82 301	40	153	82 314
41	137	83 279	41	144	83 291	41	150	83 305	41	157	83 318
42	141	84 282	42	147	84 295	42	154	84 308	42	161	84 322
43	144	85 285	43	151	85 298	43	158	85 312	43	165	85 326
44	148	86 289	44	154	86 302	44	161	86 316	44	168	86 330
45	151	87 292	45	158	87 306	45	165	87 319	45	172	87 333
46	154	88 296	46	161	88 309	46	169	88 323	46	176	88 337
47	158	89 299	47	165	89 313	47	172	89 327	47	180	89 341
48	161	90 302	48	169	90 316	48	176	90 330	48	184	90 345
49	164	91 306	49	172	91 319	49	180	91 334	49	188	91 349
50	168	92 309	50	176	92 323	50	183	92 337	50	192	92 352

Side 24 Ins.	51	204	Side 24½ Ins.	51	212	Side 25 Ins.	51	221	Side 25½ Ins.	51	230
Ft. long.	52	208	Ft. long.	52	217	Ft. long.	52	225	Ft. long.	52	235
	53	212		53	221		53	230		53	239
	54	216		54	225		54	234		54	244
	55	220		55	229		55	239		55	248
14	55	224	14	56	233	14	56	243	14	56	253
15	60	228	15	62	237	15	57	247	15	57	257
16	64	232	16	66	242	16	58	252	16	58	262
17	68	236	17	71	246	17	59	256	17	59	266
18	72	240	18	75	250	18	60	260	18	60	271
19	76	244	19	79	254	19	61	265	19	61	275
20	80	248	20	83	258	20	62	269	20	62	280
21	84	252	21	87	262	21	63	273	21	63	284
22	88	256	22	91	267	22	64	278	22	64	289
23	92	260	23	96	271	23	65	282	23	65	293
24	96	264	24	100	275	24	66	286	24	66	298
25	100	268	25	104	279	25	67	291	25	67	302
26	104	272	26	108	283	26	68	295	26	68	307
27	108	276	27	112	287	27	69	299	27	69	311
28	112	280	28	116	292	28	70	304	28	70	316
29	116	284	29	121	296	29	71	308	29	71	320
30	120	288	30	125	300	30	72	312	30	72	325
31	124	292	31	129	304	31	73	317	31	73	329
32	128	296	32	133	308	32	74	321	32	74	334
33	132	300	33	137	313	33	75	325	33	75	338
34	136	304	34	141	317	34	76	330	34	76	343
35	140	308	35	146	321	35	77	334	35	77	347
36	144	312	36	150	325	36	78	338	36	78	352
37	148	316	37	154	329	37	79	343	37	79	356
38	152	320	38	158	333	38	80	347	38	80	361
39	156	324	39	162	337	39	81	351	39	81	366
40	160	328	40	166	342	40	82	356	40	82	370
41	164	332	41	171	346	41	83	360	41	83	375
42	168	336	42	175	350	42	84	364	42	84	379
43	172	340	43	179	354	43	85	369	43	85	384
44	176	344	44	183	358	44	86	373	44	86	388
45	180	348	45	187	362	45	87	377	45	87	393
46	184	352	46	192	367	46	88	382	46	88	397
47	188	356	47	196	371	47	89	386	47	89	402
48	192	360	48	200	375	48	90	390	48	90	406
49	196	364	49	204	379	49	91	395	49	91	411
50	200	368	50	208	383	50	92	399	50	92	415

Side 26	51	239				Side 26½	51	248				Side 27	51	258			
	Ins.	52	44	53	49		Ins.	52	53	53	58		Ins.	52	63	53	68
Ft. long.	Cents.	53	49	54	53	Ft. long.	Cents.	53	58	54	63	Ft. long.	Cents.	53	68	54	73
		54	53	55	58			54	63	55	68			54	73	55	78
14	65	56	63	14	68	56	73	14	71	56	83	14	75	56	94		
15	70	57	67	15	73	57	78	15	76	57	88	15	79	57	99		
16	75	58	72	16	78	58	83	16	81	58	93	16	84	58	304		
17	80	59	77	17	83	59	88	17	86	59	98	17	89	59	10		
18	84	60	81	18	88	60	93	18	91	60	304	18	94	60	15		
19	89	61	86	19	92	61	97	19	96	61	09	19	100	61	20		
20	94	62	91	20	97	62	302	20	101	62	14	20	05	62	25		
21	98	63	96	21	102	63	07	21	06	63	19	21	10	63	30		
22	103	64	300	22	07	64	12	22	11	64	24	22	15	64	36		
23	08	65	05	23	12	65	17	23	16	65	29	23	21	65	41		
24	13	66	10	24	17	66	22	24	21	66	34	24	26	66	46		
25	17	67	14	25	22	67	27	25	26	67	39	25	31	67	52		
26	22	68	19	26	27	68	31	26	32	68	44	26	36	68	57		
27	27	69	24	27	31	69	36	27	37	69	49	27	42	69	62		
28	32	70	28	28	36	70	41	28	42	70	54	28	47	70	67		
29	36	71	33	29	41	71	46	29	47	71	59	29	52	71	73		
30	41	72	38	30	46	72	51	30	52	72	64	30	57	72	78		
31	45	73	42	31	51	73	56	31	57	73	70	31	63	73	83		
32	50	74	47	32	56	74	61	32	62	74	75	32	68	74	88		
33	55	75	52	33	61	75	66	33	67	75	80	33	73	75	94		
34	59	76	57	34	66	76	70	34	72	76	85	34	78	76	99		
35	64	77	61	35	70	77	75	35	77	77	90	35	84	67	404		
36	69	78	66	36	75	78	80	36	82	78	95	36	89	78	09		
37	73	79	71	37	80	79	85	37	87	79	400	37	94	79	15		
38	78	80	75	38	85	80	90	38	92	80	05	38	99	80	21		
39	83	81	80	39	90	81	95	39	97	81	10	39	205	81	25		
40	88	82	85	40	95	82	400	40	202	82	15	40	10	82	30		
41	92	83	89	41	200	83	05	41	08	83	20	41	15	83	35		
42	97	84	94	42	05	84	09	42	13	84	25	42	20	84	40		
43	202	85	99	43	09	85	14	43	18	85	30	43	26	85	46		
44	06	86	403	44	14	86	19	44	23	86	35	44	31	86	51		
45	11	87	08	45	19	87	24	45	28	87	40	45	36	87	57		
46	16	88	13	46	24	88	29	46	33	88	45	46	41	88	62		
47	21	89	18	47	29	89	34	47	38	89	50	47	47	89	67		
48	25	90	22	48	34	90	39	48	43	90	55	18	52	90	72		
49	30	91	27	49	39	91	44	49	48	91	60	49	57	91	78		
50	34	92	32	50	44	92	49	50	53	92	65	50	62	92	82		

Side 28		51	277	Side 28½		51	288	Side 29		51	298	Side 29½		51	308
	Ins.	52	83		Ins.	52	95		Ins.	52	304		Ins.	52	14
Ft. long.		53	89	Ft. long.		53	99	Ft. long.		53	09	Ft. long.		53	20
	Cont.	54	94		Cont.	54	304		Cont.	54	15		Cont.	54	26
		55	99			55	10			55	21			55	32
14	76	56	305	14	79	56	16	14	82	56	27	14	85	56	38
15	82	57	10	15	85	57	21	15	88	57	33	15	90	57	44
16	87	58	15	16	90	58	27	16	93	58	39	16	97	58	50
17	93	59	21	17	96	59	32	17	99	59	44	17	103	59	56
18	98	60	27	18	101	60	38	18	105	60	50	18	09	60	62
19	103	61	32	19	07	61	44	19	11	61	56	19	15	61	69
20	09	62	37	20	13	62	49	20	17	62	62	20	21	62	75
21	15	63	43	21	18	63	55	21	23	63	68	21	27	63	81
22	20	64	48	22	24	64	61	22	28	64	74	22	33	64	87
23	25	65	54	23	30	65	67	23	34	65	79	23	39	65	93
24	31	66	59	24	35	66	72	24	40	66	85	24	45	66	99
25	36	67	65	25	41	67	78	25	46	67	91	25	51	67	405
26	42	68	70	26	47	68	83	26	52	68	97	26	57	68	11
27	47	69	75	27	52	69	89	27	58	69	403	27	63	69	17
28	52	70	81	28	58	70	95	28	64	70	09	28	69	70	23
29	58	71	86	29	63	71	400	29	69	71	15	29	75	71	29
30	63	72	92	30	69	72	06	30	75	72	20	30	81	72	35
31	69	73	97	31	75	73	12	31	81	73	26	31	87	73	41
32	74	74	403	32	80	74	17	32	87	74	32	32	93	74	47
33	80	75	08	33	86	75	23	33	93	75	38	33	99	75	53
24	85	76	14	34	92	76	29	34	98	76	44	34	205	76	59
35	91	77	19	35	97	77	34	35	204	77	50	35	11	77	65
36	96	78	25	36	203	78	40	36	10	78	55	36	18	78	71
37	201	79	30	37	09	79	45	37	16	79	61	37	24	79	77
38	07	80	35	38	14	80	51	38	22	80	67	38	30	80	83
39	12	81	41	39	20	81	57	39	28	81	73	39	35	81	89
40	18	82	46	40	25	82	62	40	33	82	79	40	42	82	95
41	23	83	52	41	31	83	68	41	39	83	85	41	48	83	501
42	29	84	57	42	37	84	74	42	45	84	91	42	54	84	07
43	34	85	63	43	42	85	79	43	51	85	96	43	60	85	13
44	39	86	68	44	48	86	85	44	57	86	502	44	66	86	20
45	45	87	74	45	54	87	90	45	63	87	08	45	72	87	25
46	50	88	79	46	59	88	96	46	67	88	14	46	78	88	32
47	56	89	85	47	65	89	502	47	74	89	20	47	84	89	38
48	64	90	90	48	70	90	07	48	80	90	25	48	90	90	44
49	67	91	95	49	76	91	13	49	80	91	31	49	96	91	50
50	72	92	501	50	82	92	18	50	94	92	37	50	302	92	56

Diameter, Ins.	7 Ft. Long. Contents.		Diameter, Ins.	8 Ft. Long. Contents.		Diameter, Ins.	9 Ft. Long. Contents.		Diameter, Ins.	10 Ft. Long. Contents.		Diameter, Ins.	11 Ft. Long. Contents.	
6	1	4	6	1	6	6	1	8	6	2	0	6	2	1
7	1	8	7	2	1	7	2	4	7	2	7	7	2	9
8	2	4	8	2	8	8	3	1	8	3	5	8	3	8
9	3	1	9	3	5	9	3	9	9	4	4	9	4	8
10	3	8	10	4	3	10	4	9	10	5	4	10	6	0
11	4	6	11	5	3	11	5	9	11	6	6	11	7	4
12	5	5	12	6	3	12	7	1	12	7	8	12	8	6
13	6	4	13	7	3	13	8	5	13	9	4	13	10	0
14	7	5	14	8	5	14	9	6	14	10	6	14	11	7
15	8	6	15	9	8	15	11	1	15	12	4	15	13	6
16	9	7	16	11	2	16	12	6	16	14	0	16	15	3
17	11	0	17	12	6	17	14	1	17	15	7	17	17	3
18	12	3	18	14	1	18	15	9	18	17	7	18	19	4
19	13	7	19	15	7	19	17	7	19	19	7	19	21	6
20	45	3	20	17	5	20	19	6	20	21	6	20	23	9
21	16	7	21	19	2	21	21	5	21	23	8	21	26	3
22	18	4	22	21	0	22	23	6	22	26	3	22	28	8
23	20	2	23	22	9	23	25	9	23	28	8	23	31	5
24	21	8	24	25	0	24	28	4	24	31	3	24	35	3
25	23	7	25	27	2	25	30	7	25	34	0	25	37	3
26	25	7	26	29	4	26	32	1	26	36	0	26	40	4
27	27	6	27	31	6	27	35	0	27	39	7	27	43	2
28	29	7	28	33	9	28	38	4	28	42	5	28	46	6
29	31	8	29	36	3	29	41	0	29	45	5	29	50	0
30	34	2	30	39	0	30	43	9	30	49	0	30	53	5
31	36	6	31	41	8	31	47	0	31	52	2	31	57	2
32	38	9	32	44	5	32	52	2	32	55	0	32	61	2
33	41	4	33	47	2	33	53	3	33	59	1	33	65	0
34	43	7	34	50	3	34	56	3	34	62	9	34	69	0
35	46	5	35	53	0	35	59	8	35	66	5	35	73	0
36	49	2	36	56	0	36	63	2	36	70	5	36	79	0
37	52	0	37	59	4	37	67	0	37	74	5	37	81	8
38	54	7	38	62	8	38	70	6	38	78	8	38	86	3
39	57	8	39	66	3	39	74	4	39	83	3	39	91	0
40	60	8	40	69	6	40	78	3	40	87	3	40	95	7

Diameter, Ins.	12 Ft. Long. Contents.		Diameter, Ins.	13 Ft. Long. Contents.		Diameter, Ins.	14 Ft. Long. Contents.		Diameter, Ins.	15 Ft. Long. Contents.		Diameter, Ins.	16 Ft. Long. Contents.	
6	2	5	6	2	5	6	2	7	6	2	9	6	3	1
7	3	2	7	3	5	7	3	7	7	4	0	7	4	2
8	4	2	8	4	5	8	4	8	8	5	2	8	5	5
9	5	3	9	5	7	9	6	1	9	6	6	9	7	0
10	6	5	10	7	1	10	7	6	10	8	1	10	8	7
11	7	9	11	8	5	11	9	3	11	9	8	11	10	5
12	9	4	12	10	2	12	11	0	12	11	8	12	12	5
13	11	1	13	11	9	13	12	8	13	13	8	13	14	6
14	12	8	14	13	9	14	14	9	14	16	0	14	17	0
15	14	9	15	16	1	15	17	2	15	18	5	15	19	7
16	16	8	16	18	2	16	19	5	16	20	8	16	22	3
17	18	9	17	20	4	17	21	8	17	23	5	17	25	0
18	21	3	18	22	8	18	24	5	18	26	4	18	28	2
19	23	5	19	25	5	19	27	3	19	29	3	19	31	3
20	26	2	20	28	2	20	30	3	20	32	5	20	34	6
21	28	7	21	31	0	21	33	3	21	35	8	21	38	1
22	31	5	22	34	0	22	36	6	22	39	2	22	41	8
23	34	5	23	37	3	23	40	2	23	42	8	23	45	7
24	37	6	24	40	6	24	43	6	24	46	7	24	49	6
25	40	7	25	44	0	25	47	4	25	50	7	25	53	9
26	44	0	26	47	7	26	51	3	26	54	8	26	58	3
27	47	4	27	51	3	27	55	0	27	58	9	27	63	0
28	51	0	28	55	2	28	59	2	28	63	5	28	67	6
29	54	5	29	58	9	29	63	4	29	68	0	29	72	4
30	58	4	30	63	4	30	68	0	30	73	3	30	77	7
31	62	5	31	67	7	31	72	7	31	78	2	31	83	3
32	66	7	32	72	4	32	77	5	32	83	5	32	88	7
33	71	0	33	76	8	33	82	5	33	88	6	33	94	5
34	75	3	34	81	4	34	87	5	34	94	3	34	99	6
35	79	8	35	86	4	35	92	8	35	99	5	35	106	8
36	84	4	36	91	3	36	98	0	36	105	5	36	112	9
37	89	5	37	96	8	37	104	7	37	112	0	37	119	5
38	94	4	38	102	6	38	110	0	38	117	7	38	126	0
39	99	3	39	108	3	39	115	9	39	124	7	39	132	8
40	104	4	40	113	4	40	124	0	40	130	5	40	139	5

Diameter, Ins.	17 Ft. Long. Contents.		Diameter, Ins.	18 Ft. Long. Contents.		Diameter, Ins.	19 Ft. Long. Contents.		Diameter, Ins.	20 Ft. Long. Contents.		Diameter, Ins.	21 Ft. Long. Contents.	
6	3	3	6	3	5	6	3	7	6	3	9	6	4	1
7	4	5	7	4	6	7	5	1	7	5	3	7	5	6
8	5	9	8	6	3	8	6	8	8	7	0	8	7	3
9	7	5	9	8	0	9	8	4	9	8	8	9	9	4
10	9	3	10	9	8	10	10	4	10	11	0	10	11	5
11	11	2	11	11	9	11	12	0	11	13	3	11	13	9
12	13	4	12	14	2	12	15	0	12	15	8	12	16	6
13	17	7	13	16	1	13	17	6	13	18	5	13	19	5
14	18	5	14	19	3	14	20	7	14	21	4	14	22	5
15	21	1	15	22	3	15	23	6	15	24	7	15	26	2
16	23	8	16	25	2	16	26	7	16	28	2	16	29	5
17	26	8	17	28	3	17	30	0	17	31	6	17	33	3
18	30	1	18	31	9	18	33	6	18	35	4	18	37	2
19	33	5	19	35	4	19	37	5	19	39	4	19	41	5
20	37	2	20	39	2	20	41	5	20	43	7	20	46	0
21	40	9	21	43	1	21	45	6	21	48	4	21	50	4
22	44	7	22	47	4	22	50	2	22	52	7	22	55	2
23	49	1	23	51	8	23	54	8	23	57	7	23	60	8
24	53	5	24	56	1	24	59	5	24	62	9	24	66	2
25	57	7	25	61	4	25	64	8	25	68	5	26	71	8
26	62	6	26	66	4	26	70	2	26	74	0	26	77	6
27	67	5	27	71	5	27	75	4	27	79	5	27	83	5
28	72	6	28	77	2	28	81	3	28	85	6	28	90	0
9	77	7	29	82	4	29	87	2	29	91	5	29	96	3
30	83	5	30	88	4	30	93	5	30	98	5	30	103	4
31	89	4	31	94	5	31	99	5	31	105	3	31	111	0
32	95	5	32	101	0	32	106	8	32	112	4	32	118	0
33	101	5	33	107	3	33	113	4	33	119	5	33	125	4
34	107	8	34	113	8	34	120	0	34	126	7	34	133	0
35	114	0	35	120	5	35	127	2	35	135	0	35	141	0
36	120	6	36	127	5	36	135	0	36	142	2	36	149	0
37	127	6	37	135	5	37	143	0	37	150	9	37	157	6
38	134	8	38	142	6	38	150	8	38	159	0	38	166	5
39	142	0	39	150	5	39	159	0	39	167	9	39	176	0
40	149	5	40	158	0	40	167	0	40	176	0	40	185	0

Diameter, Ins.	22 Ft. Long. Contents.		Diameter, Ins.	23 Ft. Long. Contents.		Diameter, Ins.	24 Ft. Long. Contents.		Diameter, Ins.	25 Ft. Long. Contents.		Diameter, Ins.	26 Ft. Long. Contents.	
6	4	3	6	4	5	6	4	7	6	4	9	6	5	1
7	5	9	7	6	1	7	6	4	7	6	7	7	6	9
8	7	7	8	8	0	8	8	4	8	8	8	8	9	1
9	9	7	9	10	2	9	10	3	9	11	1	9	11	5
10	12	1	10	12	6	10	13	2	10	13	7	10	14	2
11	14	6	11	15	3	11	15	9	11	16	6	11	16	3
12	17	4	12	18	2	12	19	1	12	19	8	12	20	5
13	20	4	13	21	3	13	22	2	13	23	0	13	23	9
14	23	6	14	24	5	14	25	7	14	26	7	14	27	8
15	27	4	15	28	6	15	29	7	15	31	0	15	32	3
16	31	0	16	32	3	16	33	7	16	35	0	16	36	5
17	34	9	17	36	3	17	38	0	17	39	6	17	41	0
18	39	0	18	40	7	18	42	5	18	44	3	18	46	0
19	43	3	19	45	2	19	47	3	19	49	4	19	51	2
20	48	3	20	50	3	20	52	5	20	54	7	20	56	7
21	53	0	21	55	2	21	57	7	21	60	0	21	62	5
22	58	1	22	60	7	22	63	5	22	66	0	22	68	7
23	63	7	23	66	2	23	69	5	23	72	3	23	75	2
24	69	4	24	72	3	24	75	4	24	78	6	24	81	9
25	75	3	25	78	5	25	82	3	25	85	7	25	88	5
26	81	5	26	85	3	26	88	7	26	93	5	26	96	0
27	87	7	27	91	5	27	96	0	27	99	3	27	103	4
28	94	5	28	98	5	28	103	2	28	107	3	28	111	3
29	101	0	29	105	6	29	110	7	29	114	8	29	119	5
30	108	8	30	113	5	30	118	6	30	123	3	30	128	0
31	116	0	31	121	4	31	126	8	31	131	5	31	137	0
32	124	0	32	129	5	32	135	5	42	140	6	32	145	5
33	131	5	33	138	0	33	144	0	33	149	0	33	155	0
34	139	4	34	145	7	34	152	5	34	158	6	34	164	0
35	147	7	35	154	7	35	161	5	35	167	5	35	174	0
36	156	5	36	163	5	36	171	0	36	178	0	36	185	0
37	165	5	38	173	5	36	181	5	37	188	0	37	195	5
38	174	5	38	183	0	38	191	0	38	198	0	38	206	0
39	184	4	39	192	5	39	202	0	39	208	5	39	217	0
40	193	5	40	204	0	40	213	2	40	218	5	40	228	0

27 Ft. Long.			28 Ft. Long.			29 Ft. Long.			30 Ft. Long.			31 Ft. Long.		
Diameter, Ins.	Contents.		Diameter, Ins.	Contents.		Diameter, Ins.	Contents.		Diameter, Ins.	Contents.		Diameter, Ins.	Contents.	
6	5	3	6	5	5	6	5	7	6	5	9	6	6	1
7	7	2	7	7	5	7	7	8	7	8	0	7	8	3
8	9	4	8	9	7	8	10	1	8	10	3	8	10	8
9	11	9	9	12	4	9	12	8	9	13	1	9	13	7
10	14	8	10	15	4	10	15	9	10	16	4	10	17	1
11	17	9	11	18	6	11	19	2	11	19	8	11	20	6
12	21	3	12	22	1	12	23	9	12	23	6	12	24	4
13	24	9	13	25	8	13	26	7	13	27	7	13	28	6
14	28	9	14	30	1	14	31	2	14	32	1	14	33	3
15	33	5	15	34	7	15	36	1	15	37	3	15	38	5
16	37	9	16	39	3	16	40	7	16	42	0	16	43	4
17	42	6	17	44	2	17	45	6	17	47	2	17	48	6
18	47	8	18	49	7	18	51	3	18	52	7	18	54	6
19	53	3	19	55	1	19	57	0	19	58	8	19	61	1
20	59	2	20	61	3	20	63	5	20	65	5	20	67	7
21	65	0	21	67	2	21	69	7	21	72	0	21	75	5
22	71	5	22	74	0	22	76	5	22	79	0	22	82	0
23	78	5	23	81	0	23	83	7	23	86	5	23	89	5
24	85	3	24	88	0	24	91	2	24	94	2	24	97	5
25	92	5	25	95	6	25	99	0	25	102	7	25	106	0
26	99	7	26	103	5	26	107	5	26	111	2	26	114	7
27	107	7	27	111	7	27	115	5	27	119	4	27	123	3
28	116	0	28	120	0	28	124	7	28	128	8	28	132	7
29	124	2	29	128	7	29	133	0	29	138	0	29	142	0
30	133	2	30	136	0	30	143	1	30	148	0	30	152	4
31	142	3	31	147	5	31	152	7	31	158	3	31	163	0
32	152	1	32	157	3	32	163	0	32	169	0	32	174	0
33	161	8	33	167	0	33	173	0	33	179	7	33	185	4
34	171	5	34	178	0	34	184	0	34	190	5	34	196	0
35	182	0	35	188	7	35	194	7	35	202	5	35	208	0
36	192	5	36	199	0	36	206	0	36	213	0	36	218	5
37	206	0	37	211	0	37	217	5	37	225	0	37	232	5
38	214	1	38	222	1	38	228	5	38	236	1	38	244	0
39	226	3	39	234	0	39	242	0	39	251	0	39	258	0
40	237	5	40	245	3	40	254	5	40	263	7	40	272	0

Diameter, Ins.	32 Ft. Long. Contents.		Diameter, Ins.	33 Ft. Long. Contents.		Diameter, Ins.	34 Ft. Long. Contents.		Diameter, Ins.	35 Ft. Long. Contents.		Diameter, Ins.	36 Ft. Long. Contents.	
6	6	3	6	6	5	6	6	7	6	6	9	6	7	1
7	8	6	7	8	8	7	9	1	7	9	4	7	9	6
8	11	1	8	11	5	8	11	9	8	12	3	8	12	6
9	14	2	9	14	6	9	15	1	9	15	5	9	15	9
10	17	6	10	18	2	10	18	7	10	19	3	10	19	7
11	21	2	11	21	7	11	22	5	11	23	2	11	23	7
12	25	4	12	26	1	12	26	7	12	27	7	12	28	4
13	29	5	13	30	6	13	31	4	13	32	3	13	33	3
14	34	3	14	35	4	14	36	5	14	37	6	14	38	7
15	39	7	15	41	1	15	42	2	15	43	3	15	44	5
16	45	0	16	46	3	16	47	7	16	49	2	16	50	4
17	50	5	17	52	0	17	53	4	17	55	2	17	56	5
18	56	5	18	58	3	18	60	1	18	62	0	18	63	6
19	63	0	19	65	0	19	67	0	19	69	0	19	70	9
20	70	2	20	72	2	20	74	4	20	76	7	20	79	0
21	76	7	21	79	5	21	81	7	21	84	4	21	86	5
22	84	5	22	87	2	22	89	5	22	92	5	22	95	4
23	92	4	23	95	5	23	98	3	23	101	2	23	104	5
24	100	8	24	104	0	24	107	0	24	10	5	24	13	5
25	09	5	25	13	0	25	15	7	25	19	5	25	23	0
26	18	5	26	22	0	26	25	8	26	29	5	26	33	0
27	27	5	27	31	5	27	35	2	27	39	5	27	42	5
28	37	5	28	41	5	28	45	5	28	50	3	28	54	4
29	46	4	29	51	6	29	55	5	29	61	0	29	65	0
30	57	0	30	62	6	30	67	0	30	72	5	30	77	5
31	69	0	31	74	0	31	79	0	31	82	4	31	90	0
32	80	0	32	85	5	32	91	0	32	97	0	32	202	0
33	91	2	33	97	0	33	202	5	33	208	0	33	14	0
34	202	5	34	208	2	34	14	3	34	20	0	34	27	0
35	14	0	35	20	5	35	27	0	35	34	0	35	40	0
36	26	5	36	33	5	36	40	0	36	47	0	36	55	0
37	40	0	37	47	5	37	54	3	37	62	5	37	69	5
38	53	5	38	61	5	38	68	0	38	76	4	38	84	0
39	67	0	39	75	0	39	83	2	39	92	5	39	300	0
40	80	0	40	88	5	40	97	3	40	306	4	40	16	2

Diameter, Ins.	37 Ft. Long. Contents.		Diameter, Ins.	38 Ft. Long. Contents.		Diameter. Ins.	39 Ft. Long. Contents.		Diameter, Ins.	40 Ft. Long. Contents.		Diameter, Ins.	41 Ft. Long. Contents.	
6	7	3	6	7	4	6	7	7	6	7	8	6	8	0
7	9	9	7	10	2	7	10	4	7	10	3	7	10	5
8	12	9	8	13	3	8	13	7	8	14	0	8	14	3
9	16	3	9	16	8	9	17	3	9	17	7	9	18	1
10	20	8	10	20	7	10	21	6	10	21	7	10	22	3
11	24	4	11	25	2	11	25	7	11	26	4	11	28	7
12	29	2	12	29	9	12	30	8	12	31	5	12	32	2
13	34	0	13	35	0	13	36	1	13	36	8	13	37	7
14	39	6	14	40	7	14	41	7	14	42	7	14	43	5
15	45	8	15	47	0	15	48	4	15	49	5	15	50	6
16	51	7	16	53	3	16	54	5	16	55	7	16	57	0
17	58	2	17	59	7	17	62	5	17	62	9	17	64	2
18	65	4	18	67	0	18	69	0	18	70	5	18	74	3
19	72	8	19	74	7	19	76	7	19	78	7	19	80	4
20	81	0	20	83	3	20	85	5	20	87	5	20	89	0
21	88	8	21	91	3	21	93	7	21	96	0	21	98	4
22	97	7	22	100	5	22	103	2	22	106	0	22	108	6
23	107	3	23	10	0	23	13	0	23	15	5	23	19	5
24	16	6	24	19	5	24	23	0	24	26	0	24	29	0
25	27	0	25	30	0	25	33	5	25	37	3	25	40	4
26	37	5	26	41	5	26	44	4	26	48	0	26	51	5
27	47	5	27	51	0	27	55	5	27	59	5	27	63	0
28	59	0	28	63	0	28	67	0	28	72	0	28	75	2
29	70	7	29	74	5	29	89	0	29	82	0	29	88	0
30	83	0	30	87	5	30	92	5	30	97	0	30	202	0
31	95	1	31	200	5	31	205	0	31	211	0	31	14	5
32	207	9	32	12	4	32	18	0	32	24	0	32	28	0
33	21	0	33	26	5	32	32	5	33	38	2	33	43	5
34	34	0	34	39	0	34	46	0	34	53	0	34	58	0
35	47	0	35	54	0	35	62	0	35	68	0	35	74	0
36	62	5	36	67	5	36	76	0	36	83	0	36	89	0
37	76	5	37	85	0	37	93	5	37	300	0	37	307	0
38	92	5	38	300	0	38	309	0	38	16	5	38	24	0
39	309	0	39	16	5	39	26	2	39	34	0	39	41	2
40	25	0	40	33	0	40	41	4	40	49	5	40	59	0

Diameter, Ins.	42 Ft. Long. Contents.		Diameter, Ins.	43 Ft. Long. Contents.		Diameter, Ins.	44 Ft. Long. Contents.		Diameter, Ins.	45 Ft. Long. Contents.		Diameter, Ins.	46 Ft. Long. Contents.	
6	8	2	6	8	4	6	8	7	6	8	8	6	9	0
7	11	3	7	11	5	7	11	7	7	12	0	7	12	3
8	14	7	8	15	1	8	15	4	8	15	7	8	16	1
9	19	5	9	19	1	9	19	4	9	19	8	9	20	4
10	22	9	10	23	5	10	24	0	10	24	5	10	25	3
11	27	7	11	28	4	11	29	2	11	29	6	11	30	5
12	33	0	12	33	9	12	34	7	12	35	4	12	36	4
13	38	7	13	39	7	13	40	5	13	41	4	13	42	5
14	44	7	14	45	9	14	46	9	14	48	0	14	49	4
15	51	7	15	53	3	15	52	2	15	55	5	15	57	0
16	58	5	16	60	4	16	61	4	16	62	8	16	64	6
17	66	0	17	67	7	17	69	4	17	70	7	17	72	7
18	74	2	18	76	0	18	77	6	18	79	5	18	81	5
19	82	5	19	84	6	19	86	5	19	88	4	19	90	8
20	91	5	20	94	5	20	96	3	20	98	5	20	100	5
21	100	8	21	103	4	21	105	5	21	108	3	21	10	5
22	11	0	22	13	5	22	16	0	22	18	4	22	21	5
23	21	3	23	24	5	23	27	3	23	29	5	23	33	0
24	32	0	24	35	0	24	38	7	24	41	5	24	44	5
25	43	5	25	47	3	25	50	5	25	53	7	25	57	0
26	55	0	26	59	0	26	62	7	26	66	5	26	70	5
27	67	0	27	71	0	27	75	0	27	79	0	27	83	0
28	80	2	28	84	7	28	88	5	28	93	0	28	97	0
29	92	8	29	97	0	29	201	5	29	213	0	29	211	0
30	206	5	30	211	5	30	15	0	30	21	0	30	25	0
31	20	0	31	25	2	31	21	0	31	36	0	31	42	0
32	34	5	32	41	0	32	45	4	32	52	5	32	57	5
33	49	0	33	56	1	33	62	0	33	67	5	33	73	0
34	64	0	34	71	5	34	76	5	34	83	5	34	89	0
35	82	1	35	87	0	35	94	0	35	301	5	35	307	5
36	96	0	36	304	0	36	310	3	36	17	5	36	25	0
37	314	5	37	22	7	37	28	0	37	36	5	37	44	0
38	32	1	38	37	5	38	45	0	38	55	0	38	63	2
39	49	0	39	57	1	39	66	4	39	75	0	38	84	0
40	67	3	40	77	0	40	85	2	40	94	0	40	403	1

Diameter, Ins.	47 Ft. Long. Contents.		Diameter, Ins.	48 Ft. Long. Contents.		Diameter, Ins.	49 Ft. Long. Contents.		Diameter, Ins.	50 Ft. Long. Contents.		Diameter, Ins.	51 Ft. Long. Contents.	
6	9	2	6	9	4	6	9	6	6	9	8	6	9	9
7	12	6	7	12	8	7	13	1	7	13	4	7	13	7
8	16	4	8	16	7	8	17	1	8	17	5	8	17	8
9	20	7	9	21	1	9	21	6	9	22	0	9	22	5
10	25	7	10	26	3	10	26	7	10	27	3	10	27	8
11	31	0	11	31	7	11	32	3	11	32	9	11	33	7
12	37	0	12	37	7	12	38	5	12	39	3	12	40	1
13	43	3	13	44	0	13	45	0	13	45	9	13	46	9
14	50	4	14	51	2	14	52	3	14	53	2	14	54	6
15	58	0	15	59	1	15	60	5	15	61	7	15	63	2
16	65	6	16	67	0	16	68	5	16	70	0	16	71	5
17	73	8	17	75	3	17	77	0	17	78	8	17	80	4
18	83	3	18	84	5	18	86	4	18	88	0	18	90	3
19	92	4	19	94	3	19	96	3	19	98	3	19	100	7
20	102	5	20	105	0	20	107	0	20	109	3	20	12	0
21	13	0	21	15	3	21	17	4	21	20	0	21	21	5
22	23	5	22	26	7	22	29	0	22	32	0	22	35	0
23	35	5	23	38	5	23	41	5	23	44	0	33	47	5
24	47	0	24	50	8	24	53	5	24	57	0	24	60	7
25	60	5	25	63	5	25	67	0	25	71	0	25	72	5
26	73	2	26	77	5	26	81	5	26	83	2	26	89	0
27	87	0	27	91	0	27	95	0	27	98	4	27	202	5
28	201	5	28	205	0	28	209	0	28	214	0	28	17	5
29	14	0	29	18	0	29	24	0	29	28	0	29	33	5
30	30	0	30	35	7	30	40	3	30	45	0	30	50	0
31	45	5	31	52	0	31	57	0	31	62	5	31	67	5
32	62	5	32	67	2	32	74	0	32	78	5	32	85	0
33	78	0	33	85	0	33	91	5	33	96	5	33	303	5
34	95	0	34	302	5	34	308	0	34	315	0	24	21	5
35	313	4	35	20	0	35	27	2	35	33	5	35	40	0
36	32	1	36	38	0	36	45	0	36	53	0	36	61	0
37	52	0	37	59	1	37	66	3	37	74	0	37	82	5
38	70	0	38	78	7	38	86	5	38	94	0	38	403	0
39	90	0	39	98	5	39	407	5	39	416	0	39	23	5
40	411	2	40	418	5	40	27	6	40	36	5	40	46	0

Diameter, Ins.	52 Ft. Long. Contents.	Diameter, Ins.	53 Ft. Long. Contents.	Diameter, Ins.	54 Ft. Long. Contents.	Diameter, Ins.	55 Ft. Long. Contents.	Diameter, Ins.	56 Ft. Long. Contents.
6	10 2	6	10 4	6	10 6	6	10 8	6	11 0
7	13 9	7	14 1	7	14 4	7	14 7	7	14 9
8	18 2	8	18 5	8	18 8	8	19 3	8	19 5
9	22 8	9	23 3	9	23 7	9	24 3	9	24 7
10	28 4	10	28 8	10	29 4	10	30 0	10	30 7
11	34 3	11	34 9	11	35 5	11	36 4	11	36 8
12	40 9	12	41 5	12	42 4	12	43 3	12	44 0
13	47 8	13	48 7	13	49 7	13	50 7	13	51 5
14	55 5	14	56 5	14	57 7	14	53 8	14	59 8
15	64 3	15	65 4	15	66 6	15	67 2	15	69 3
16	72 7	16	74 0	16	75 4	16	77 0	16	78 5
17	82 2	17	83 3	17	84 8	17	86 5	17	88 0
18	92 0	18	93 5	18	95 5	18	96 4	18	98 7
19	101 3	19	104 0	19	106 5	19	108 7	19	110 7
20	14 0	20	15 5	20	17 9	20	20 5	20	22 5
21	25 0	21	27 0	21	29 0	21	32 3	21	34 4
22	37 5	22	39 5	22	42 3	22	45 3	22	48 0
23	50 5	23	53 0	23	55 3	23	59 0	23	60 0
24	61 5	24	66 5	24	69 5	24	73 0	24	77 0
25	78 0	25	81 0	25	84 5	25	88 0	25	91 5
26	92 8	26	95 5	26	98 5	26	203 0	26	207 0
27	214 0	27	209 0	27	217 0	27	17 0	27	32 0
28	23 0	28	26 0	28	32 5	28	35 5	28	38 5
29	37 5	29	42 0	29	47 0	29	52 0	29	56 0
30	55 0	30	60 0	30	65 0	30	70 0	30	75 0
31	73 0	31	77 5	31	83 4	31	88 0	31	94 3
32	91 0	32	95 0	32	303 0	32	307 5	32	313 5
33	310 0	33	315 0	33	22 2	33	26 5	33	34 0
34	29 0	34	33 0	34	41 5	34	46 0	34	54 5
35	47 5	35	54 5	35	62 0	35	67 0	35	75 0
36	67 0	36	74 8	36	83 0	36	89 0	36	96 5
37	90 0	37	97 0	37	405 0	37	413 5	37	418 0
38	411 0	38	416 5	38	26 4	38	33 0	38	41 5
39	32 0	39	40 0	39	49 5	39	56 2	39	66 3
40	54 3	40	63 5	40	72 0	40	81 5	40	89 5

Diameter, Ins.	57 Ft. Long. Contents.		Diameter, Ins.	58 Ft. Long. Contents.		Diameter, Ins.	59 Ft. Long. Contents.		Diameter, Ins.	60 Ft. Long. Contents.		Diameter, Ins.	61 Ft. Long. Contents.	
6	11	2	6	11	4	6	11	5	6	11	8	6	12	0
7	15	2	7	15	5	7	15	8	7	16	0	7	16	3
8	19	3	8	20	5	8	20	6	8	20	9	8	21	3
9	25	1	9	25	7	9	26	0	9	26	4	9	26	8
10	31	2	10	31	7	10	32	3	10	32	7	10	33	4
11	37	6	11	38	4	11	38	8	11	39	6	11	40	3
12	44	3	12	45	7	12	46	5	12	47	4	12	48	0
13	52	4	13	53	5	13	54	4	13	55	4	13	56	3
14	60	3	14	62	0	14	63	3	14	64	2	14	65	3
15	70	5	15	72	2	15	73	2	15	74	3	15	75	7
16	79	7	16	81	5	16	82	7	16	84	4	16	85	5
17	89	5	17	91	5	17	92	8	17	94	5	17	96	2
18	101	0	18	103	0	18	104	8	18	106	5	18	108	5
19	12	0	19	14	5	19	16	2	19	18	0	19	20	3
20	25	0	20	27	0	20	29	0	20	31	5	20	33	5
21	37	3	21	39	6	21	42	0	21	42	6	21	46	5
22	50	4	22	43	0	22	55	7	22	58	5	22	61	4
23	64	5	23	68	0	23	71	0	23	73	5	23	77	0
24	79	5	24	83	0	24	86	0	24	89	0	24	92	8
25	85	0	25	98	2	25	202	5	25	205	0	25	207	0
26	210	0	26	213	5	26	17	5	26	21	5	26	25	0
27	25	5	27	30	0	27	34	0	27	38	0	27	42	0
28	43	5	28	47	5	28	52	5	28	57	0	28	62	2
29	62	5	29	65	0	29	70	0	29	74	2	29	79	0
30	81	5	30	85	2	30	87	5	30	94	0	30	300	0
31	300	0	31	305	0	31	309	0	31	315	0	31	21	0
32	20	2	32	25	0	32	30	0	32	35	0	32	42	5
33	40	0	33	45	5	33	52	0	33	56	5	33	64	0
34	61	5	34	65	5	34	73	5	34	78	0	34	85	0
35	82	5	35	87	0	35	95	0	35	402	3	35	408	0
36	405	0	36	409	0	36	416	3	36	24	0	36	31	5
37	27	3	37	33	3	37	42	0	37	48	0	37	56	5
38	51	0	38	56	5	38	65	0	38	74	0	38	82	0
39	75	0	39	82	0	39	91	0	39	98	5	39	507	2
40	98	5	40	506	5	40	516	2	40	524	4	40	33	3

Diameter, Ins.	62 Ft. Long. Contents.		Diameter, Ins.	63 Ft. Long. Contents.		Diameter, Ins.	64 Ft. Long. Contents.		Diameter, Ins.	65 Ft. Long. Contents.		Diameter, Ins.	66 Ft. Long. Contents.	
6	12	2	6	12	4	6	12	6	6	12	8	6	13	0
7	16	6	7	16	9	7	17	2	7	17	4	7	17	7
8	21	6	8	22	0	8	22	4	8	22	7	8	23	1
9	27	3	9	27	7	9	28	2	9	28	7	9	29	2
10	33	8	10	34	5	10	35	2	10	35	6	10	36	2
11	40	8	11	41	6	11	42	3	11	42	9	11	43	6
12	48	7	12	49	6	12	50	4	12	51	3	12	52	0
13	57	2	13	58	2	13	59	0	13	59	8	13	60	8
14	66	2	14	67	4	14	68	5	14	69	7	14	70	6
15	76	7	15	77	0	15	78	4	15	80	9	15	82	2
16	86	8	16	88	3	16	89	5	16	91	5	16	92	5
17	97	5	17	99	0	17	100	8	17	103	0	17	104	5
18	109	5	18	112	0	18	13	5	18	15	0	18	17	0
19	22	0	19	24	4	19	26	2	19	28	5	19	30	7
20	36	0	20	38	0	20	40	7	20	42	8	20	45	0
21	48	8	21	51	5	21	54	2	21	56	5	21	59	0
22	63	5	22	65	0	22	69	5	22	72	5	22	75	0
23	79	0	23	83	0	23	85	3	23	89	0	23	91	3
24	95	0	24	98	0	24	202	0	24	205	0	24	207	5
25	211	5	25	214	5	24	18	0	25	22	2	25	25	5
26	28	0	26	32	5	26	26	0	26	40	0	26	43	2
27	46	0	27	51	0	27	54	2	27	58	0	27	62	5
28	65	0	28	70	0	28	73	5	28	77	2	28	92	5
29	83	5	29	88	0	29	93	5	29	97	5	29	303	0
30	305	2	30	309	5	30	315	0	30	319	5	30	24	5
31	25	5	31	32	0	31	35	5	31	42	0	31	46	5
32	46	0	32	53	0	32	58	5	32	64	5	32	70	5
33	68	0	33	75	0	33	83	0	33	87	5	33	94	0
34	90	0	34	97	2	34	404	7	34	411	5	34	416	5
35	414	0	35	421	5	35	26	5	35	34	0	35	42	0
36	37	3	36	45	0	36	53	2	36	59	0	36	67	0
37	64	0	37	71	5	37	80	0	37	87	5	37	95	0
38	88	0	38	96	5	38	504	5	38	513	5	38	511	2
39	515	5	39	523	5	39	32	5	39	41	3	39	48	5
40	41	4	40	51	0	40	57	5	40	67	0	40	76	5

Diameter, Ins.	67 Ft. Long. Contents.		Diameter, Ins.	68 Ft. Long. Contents.		Diameter, Ins.	69 Ft. Long. Contents.		Diameter, Ins.	70 Ft. Long. Contents.		Diameter, Ins.	71 Ft. Long. Contents.	
6	13	2	6	13	4	6	13	6	6	13	7	6	13	9
7	18	0	7	18	2	7	19	5	7	18	7	7	19	0
8	23	4	8	23	6	8	24	2	8	24	4	8	24	7
9	29	5	9	29	7	9	30	3	9	30	7	9	31	3
10	36	6	10	37	2	10	37	6	10	38	2	10	38	8
11	44	2	11	44	7	11	45	5	11	46	1	11	46	7
12	52	6	12	53	4	12	54	3	12	54	9	12	56	8
13	61	5	13	62	5	13	63	5	13	64	3	13	65	0
14	71	7	14	72	5	14	73	6	14	74	5	14	75	8
15	83	4	15	84	3	15	85	5	15	86	5	15	87	8
16	94	0	16	95	3	16	96	5	16	97	8	16	99	2
17	106	0	17	107	2	17	109	0	17	110	5	17	114	0
18	18	5	18	12	5	18	22	5	18	23	5	18	25	5
19	32	5	19	34	0	19	36	5	19	38	0	19	40	0
20	46	8	20	48	5	20	51	5	20	53	0	20	55	2
21	61	2	21	63	2	21	61	5	21	68	0	21	71	0
22	78	0	22	80	5	22	83	0	22	85	0	22	88	0
23	94	0	23	96	0	23	99	0	23	204	0	23	205	0
24	211	5	24	213	0	24	216	5	24	18	0	24	22	5
25	28	0	25	32	0	25	35	5	25	37	0	25	42	0
26	47	0	26	51	5	26	55	0	26	57	5	26	62	2
27	66	5	27	69	0	27	74	0	27	76	0	27	81	5
28	86	5	28	90	0	28	94	5	28	97	5	28	303	5
29	306	5	29	311	0	29	315	5	29	318	5	29	25	0
30	28	0	30	33	0	30	37	0	30	43	0	30	48	2
31	52	0	31	56	0	31	62	0	31	66	0	31	73	0
32	75	4	32	81	5	32	87	2	32	91	0	32	97	0
33	98	5	33	404	5	33	411	5	33	415	5	33	422	5
34	422	5	34	27	0	34	34	5	34	39	0	34	46	5
35	47	0	35	53	5	35	61	0	35	66	0	35	72	0
36	74	0	36	79	0	36	88	0	36	94	0	36	501	5
37	502	0	37	507	0	37	515	5	37	503	5	37	30	0
38	27	0	38	34	0	38	43	5	38	50	0	38	57	0
39	55	5	39	63	0	39	73	5	39	80	0	39	88	5
40	84	0	40	92	2	40	603	5	40	610	0	40	618	5

Diameter, Ins.	72 Ft. Long. Contents.		Diameter, Ins.	73 Ft. Long. Contents.		Diameter, Ins.	74 Ft. Long. Contents.		Diameter, Ins.	75 Ft. Long. Contents.		Diameter, Ins.	76 Ft. Long. Contents.	
6	14	1	6	14	3	6	14	6	6	14	7	6	14	9
7	19	2	7	19	5	7	19	8	7	20	0	7	20	4
8	25	2	8	25	5	8	25	8	8	36	2	8	26	6
9	31	7	9	32	2	9	32	7	9	73	1	9	33	6
10	39	3	10	39	7	10	40	5	10	41	0	10	41	7
11	47	5	11	47	3	11	48	9	11	49	4	11	50	4
12	56	6	12	57	5	12	58	3	12	58	9	12	60	0
13	65	2	13	68	0	13	67	5	13	69	0	13	70	4
14	76	7	14	78	0	14	79	4	14	80	3	14	81	5
15	88	8	15	91	0	15	92	0	15	93	0	15	94	5
16	100	7	16	102	5	16	104	5	16	105	0	16	107	0
17	13	5	17	15	0	17	17	0	17	18	0	17	20	5
18	27	5	18	29	0	18	31	5	18	32	5	18	35	0
19	41	5	19	44	0	19	46	5	19	47	5	19	50	7
20	57	0	20	61	0	20	62	5	20	64	0	20	67	0
21	73	0	21	76	0	21	78	5	21	81	0	21	83	5
22	91	0	22	93	0	22	96	0	22	97	5	22	200	5
23	207	0	23	211	0	23	204	0	23	216	5	33	18	0
24	26	0	24	28	0	24	32	5	24	35	0	24	38	0
25	46	0	25	48	0	25	52	5	25	56	0	25	59	0
26	65	5	26	69	0	26	73	5	26	77	0	26	81	5
27	85	0	27	88	2	27	93	5	27	98	5	27	303	2
28	307	2	28	312	5	28	316	5	28	310	0	28	25	5
29	28	0	29	34	0	29	38	0	29	43	0	29	47	3
30	53	0	30	58	0	30	62	5	30	67	5	30	74	0
31	77	0	31	84	0	31	89	0	31	94	0	31	99	0
32	403	5	32	409	0	32	415	0	32	419	0	32	425	3
33	26	5	33	34	0	33	40	0	33	45	0	33	53	5
34	53	0	34	59	0	34	66	0	34	73	5	34	79	0
35	81	0	35	88	0	35	95	0	35	501	0	35	508	0
36	507	2	36	514	5	36	522	5	36	27	5	36	36	5
37	37	0	37	45	0	37	53	0	37	59	0	37	67	0
38	65	0	38	73	0	38	82	0	38	88	0	38	97	5
39	97	0	39	607	2	39	615	0	39	624	0	39	633	2
40	627	0	40	36	2	40	45	5	40	54	5	40	64	2

Diameter, Ins.	77 Ft. Long. Contents.		Diameter, Ins.	78 Ft. Long. Contents.		Diameter, Ins.	79 Ft. Long. Contents.		Diameter, Ins.	80 Ft. Long. Contents.		Diameter, Ins.	81 Ft. Long. Contents.	
6	15	1	6	15	3	6	15	5	6	15	7	6	15	8
7	20	6	7	20	8	7	21	2	7	21	3	7	21	6
8	26	8	8	27	3	8	27	5	8	27	7	8	28	2
9	33	9	9	34	4	9	34	8	9	35	2	9	35	5
10	41	9	10	42	5	10	43	3	10	43	6	10	44	0
11	50	7	11	51	4	11	52	1	11	52	6	11	53	3
12	60	4	12	61	3	12	62	2	12	62	6	12	63	5
13	70	8	13	71	7	13	72	5	13	73	4	13	74	3
14	82	5	14	83	5	14	84	5	14	85	2	14	86	3
15	95	5	15	96	5	15	96	7	15	98	8	15	99	8
16	108	5	16	109	3	16	110	8	16	112	0	16	113	0
17	21	5	17	23	0	17	24	5	17	26	3	17	27	5
18	36	7	18	38	5	18	39	5	18	41	5	18	43	0
19	51	5	19	53	3	19	54	4	19	57	0	19	59	0
20	66	0	20	71	0	20	73	0	20	75	0	20	77	0
21	85	2	21	88	0	21	90	5	21	92	5	21	94	5
22	203	0	22	206	2	22	208	0	22	210	0	22	212	5
23	22	2	23	24	5	23	27	0	23	29	1	23	32	5
24	42	0	24	44	0	24	47	5	24	51	5	24	53	5
25	63	0	25	66	0	25	69	0	25	72	5	26	75	0
26	84	0	26	87	0	26	91	0	26	94	0	26	95	5
27	305	5	27	309	0	27	314	0	27	316	3	27	321	0
28	28	0	28	33	5	28	36	0	28	41	0	28	45	0
29	53	5	29	56	0	29	62	5	29	65	0	29	68	0
30	77	5	30	83	6	30	87	0	30	92	5	30	96	5
31	404	0	31	408	5	31	414	0	31	417	5	31	422	5
32	30	0	32	35	0	32	42	0	32	45	5	32	52	0
33	58	0	33	64	2	33	68	5	33	75	0	35	79	0
34	85	1	34	92	0	34	96	5	34	503	0	34	507	5
35	514	5	35	520	0	35	526	5	35	33	3	35	36	5
36	43	5	36	50	0	36	56	0	36	62	5	36	66	5
37	74	0	37	85	0	37	89	2	37	96	0	37	604	2
38	606	0	38	614	2	38	622	5	38	628	0	38	34	5
39	40	0	39	48	3	39	57	2	39	63	5	39	69	5
40	73	1	40	82	5	40	89	5	40	97	7	40	704	5

Diameter, Ins.	82 Ft. Long. Contents.	Diameter, Ins.	83 Ft. Long. Contents.	Diameter, Ins.	84 Ft. Long. Contents.	Diameter, Ins.	85 Ft. Long. Contents.	Diameter, Ins.	86 Ft. Long. Contents.
6	16 1	6	16 2	6	16 5	6	16 7	6	16 9
7	21 8	7	22 2	7	22 4	7	22 7	7	22 9
8	28 5	8	28 8	8	29 2	8	29 5	8	29 8
9	36 0	9	36 5	9	36 7	9	37 4	9	37 8
10	44 6	10	45 3	10	45 6	10	46 4	10	46 9
11	54 3	11	54 6	11	55 2	11	55 9	11	56 5
12	64 4	12	65 2	12	65 8	12	66 6	12	67 6
13	75 5	13	76 3	13	77 0	13	78 3	13	79 3
14	87 5	14	88 5	14	89 4	14	91 0	14	92 3
15	101 5	15	102 8	15	103 8	15	105 5	15	106 9
16	14 7	16	16 2	16	17 0	16	18 8	16	20 6
17	29 0	17	31 0	17	32 0	17	34 0	17	36 0
18	46 0	18	47 0	18	48 2	18	50 5	18	52 5
19	61 0	19	63 0	19	64 5	19	67 0	19	69 0
20	79 5	20	82 5	20	83 5	20	86 5	20	89 0
21	97 0	21	99 0	21	202 0	21	204 0	21	206 7
22	216 0	22	218 0	22	20 0	22	23 5	22	27 0
23	36 5	23	38 5	23	41 5	23	44 5	23	48 0
24	56 5	24	60 0	24	62 5	24	67 0	24	70 0
25	78 5	25	83 0	25	85 0	25	88 5	25	93 5
26	302 5	26	306 0	26	307 5	26	314 0	26	315 0
27	25 0	27	28 0	27	31 5	27	36 5	27	41 0
28	49 0	28	55 5	28	57 0	28	64 3	28	67 0
29	75 0	29	78 5	29	83 2	29	87 5	29	94 0
30	403 0	30	406 5	30	410 5	30	416 5	30	422 1
31	28 2	31	34 5	31	47 5	31	45 0	31	50 0
32	57 0	32	64 0	32	66 0	32	75 0	32	82 0
33	86 0	33	94 0	33	96 5	33	505 0	33	506 5
34	515 2	34	523 2	34	525 0	34	34 2	34	42 5
35	45 0	35	53 5	35	55 5	35	65 0	35	73 5
36	76 0	36	84 0	36	89 0	36	99 2	36	607 0
37	613 0	37	621 0	36	625 0	38	636 0	37	44 5
38	44 5	38	53 5	38	57 5	38	68 0	38	77 2
39	82 5	39	89 0	39	95 0	39	706 0	39	715 0
40	714 5	40	724 0	40	731 5	40	43 5	40	52 5

Diameter, Ins.	87 Ft. Lnog. Contents.		Diameter, Ins.	88 Ft. Long. Contents.		Diameter, Ins.	89 Ft. Long. Contents.		Diameter, Ins.	90 Ft. Long. Contents.		Diameter, Ins.	91 Ft. Long. Contents.	
6	17	1	6	17	3	6	17	5	6	17	7	6	17	9
7	23	2	7	23	4	7	23	7	7	24	1	7	24	3
8	30	4	8	30	7	8	31	2	8	31	5	8	31	7
9	38	3	9	38	7	9	39	3	9	39	6	9	39	9
10	47	5	10	48	0	10	48	7	10	49	3	10	49	6
11	57	5	11	58	0	11	58	6	11	59	3	11	59	8
12	68	4	12	69	3	12	70	3	12	70	9	12	71	5
13	80	0	13	81	0	13	82	0	13	83	0	13	83	7
14	93	1	14	94	0	14	95	5	14	96	2	14	97	4
15	108	0	15	109	2	15	110	7	15	111	9	15	112	8
16	24	0	16	23	0	16	25	0	16	26	2	16	27	4
17	37	5	17	39	0	17	41	0	17	42	0	17	43	0
18	154	0	18	55	5	18	57	5	18	59	2	18	61	0
19	71	5	19	73	3	19	76	5	19	78	0	19	79	2
20	91	0	20	92	7	20	95	0	20	97	0	20	99	2
21	208	5	21	211	8	21	214	0	21	216	0	21	217	5
22	28	0	22	32	0	22	35	0	22	37	0	22	38	5
23	51	7	33	54	0	23	57	3	23	59	0	23	62	5
24	73	5	24	76	0	24	78	5	24	83	5	24	85	5
25	96	5	25	300	0	25	304	2	25	307	0	25	308	9
26	322	0	26	25	1	26	27	5	26	31	5	26	35	5
27	45	0	27	48	2	27	53	2	27	57	0	27	60	0
28	72	5	28	76	5	28	82	0	28	85	0	28	88	2
29	97	5	29	403	3	29	407	2	29	412	3	29	415	0
30	426	0	30	32	5	30	36	1	30	41	5	30	44	5
31	55	0	31	62	0	31	66	0	31	72	0	31	75	0
32	86	2	32	94	0	32	97	2	32	503	5	32	508	0
33	516	2	33	523	2	33	527	3	33	34	5	33	39	5
34	47	0	34	53	5	34	59	0	34	65	0	34	70	0
35	79	2	35	85	2	35	94	2	35	602	5	35	605	5
36	614	5	36	622	5	36	629	0	36	35	0	36	40	5
37	52	5	37	57	5	37	66	2	37	73	5	37	78	5
38	85	0	38	94	0	38	703	2	38	708	5	38	715	0
39	723	5	39	733	2	39	41	5	39	48	3	39	55	5
40	58	8	40	67	5	40	78	3	40	87	3	40	94	3

A Table giving the Side of a Square, equal to a Square inscribed in a given Circle.

The first and third columns give the diameter in inches, and extend from 6 to 49 inches; the second and fourth, give the square, or side of the stick in inches, and eighths of inches. The first and third columns at the right hand of the double line, are the same as the first mentioned, except they commence at $6\frac{5}{10}$ and extend to $49\frac{5}{10}$;—the second and fourth columns give the square, or side of the stick in inches, and hundredths of inches.

Diameter in Inches.	Square side, in Ins. and eighths of Ins.		Diameter in inches.	Square side, in Ins. and eighths of Ins.		Diameter in Inches, and tenths of Inches.		Square side, in Ins. & hundredths Ins.		Diameter in Inches, and tenths of Inches.		Square side, in Ins. & hundredths, Ins.	
6	4	2	28	19	6	6	5	4	59	28	5	20	15
7	4	7	29	20	4	7	5	5	30	29	5	20	85
8	5	5	30	21	2	8	5	6	01	30	5	21	56
9	6	3	31	21	7	9	5	6	71	31	5	22	27
10	7	0	32	22	5	10	5	7	42	32	5	22	98
11	7	6	33	23	2	11	5	8	13	33	5	23	68
12	8	4	34	24	0	12	5	8	83	33	5	24	39
13	9	1	35	24	6	13	5	9	54	35	5	25	10
14	9	7	36	25	3	14	5	10	25	36	5	25	80
15	10	5	37	26	1	15	5	10	96	37	5	26	51
16	11	2	38	26	7	16	5	11	66	38	5	27	22
17	12	0	39	27	4	17	5	12	37	39	5	27	93
18	12	6	40	28	2	18	5	13	08	40	5	28	63
19	13	3	41	29	0	19	5	13	78	41	5	29	34
20	14	1	42	29	6	20	5	14	49	42	5	30	05
21	14	7	43	30	3	21	5	15	20	43	5	30	75
22	15	4	44	31	1	22	5	15	90	44	5	31	46
23	16	2	45	31	6	23	5	16	61	45	5	32	17
24	17	0	46	32	4	24	5	17	32	46	5	32	88
25	17	5	47	33	2	25	5	18	03	47	5	33	58
26	18	3	48	33	7	26	5	18	73	48	5	34	29
27	19	0	49	34	5	27	5	19	44	49	5	35	00

OF SURVEYING.

Land is generally measured by a Chain of 66 feet in length, divided into 100 equal parts, called Links, each Link being 7,92 Inches in length. A Pole or Rod is 16½ feet or 25 links in length: hence a square pole contains 272¼ square feet, or 625 square links. An acre of land contains 160 square poles or rods, and 43560 square feet, or 100000 square links.

To find the number of square poles in any piece of land, take the dimensions of it in feet and find the area in square feet, and divide this area by 43560, the quotient will be the number of acres; or divide by 272,25 and the quotient will be the number of square poles. If the dimensions be taken in links, and the area found in square links, the number of acres may be obtained by dividing by 100000, or which is the same thing, cut off the five right hand figures; but the number of square poles may be found, by dividing by 625.

PROBLEM I. *To find the number of Acres of Land, or the number of Square Poles, in the form of a regular Paral lelogram.*

RULE. Multiply the Base or Length by the Perpendicular Height or Breadth, and if the dimensions were taken in Links, divide by 625, if in feet by 272,25, or 272¼ the quotient will be the number of Square Poles, which divided by 160 gives the number of Acres.

EXAMPLE. Suppose the Base be 60 feet and the Perpendicular 25 feet, required the Area in Square poles?

Length 60 feet
Breadth 25 feet

272,25)1500,00(5,5 Ans.
1361,25
138,750
136,125

PROBLEM II. *To find the number of Acres and Poles in a piece of Land in the form of an Oblique Angular Parallelogram.*

RULE. This Area may be found in exactly the same manner as in the preceding problem, by multiplying the Base by the Perpendicular height, and dividing by 625;

when the dimensions are taken in Links ; by 272,25, when taken in feet, the quotient will be in American Poles, which divided by 160 gives the number of Acres.

EXAMPLE. Suppose the Base be 632 and the perpendicular 326 Links ; required the number of Poles ?

Base 632 Links
Perp. 326 Links
3792
1264
1896
625)206032(329,6 Poles.
1875
1853
1250
6032
5625
4070

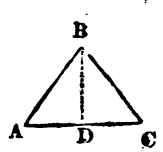
Base 632 Links
Perp. 326 Links
3792
1264
1896
Links 1,00000)2,06032
in an Acre. 4
24128
40
9,65120=to
2 Acres, 0 Roods, and $9\frac{6}{10}$ Poles.

PROBLEM III. *To find the number of Acres and Poles in a piece of Land of a Triangular form.*

RULE. Multiply the Base by the Perpendicular height, and divide the product by 1250 when the dimensions are given in Links ; by 544,5 when given in feet, and the quotients will be the answer in Poles.

Note. Instead of dividing by 1250, you may multiply by 8 and cut off the four right hand figures.

EXAMPLE. Given the Base AC equal to 300 feet, and Perpendicular BD equal to 150 feet ; required the Area in Poles.



Perpendicular 150 feet
Base 300 feet
544,5)45000,0(82,6 Poles
43560
14400
10890
35100

PROBLEM IV. *The three Sides of a Triangle being given, to find the Area Arithmetically.*

RULE. Add together the three sides, from half that sum, subtract each side, severally, noting down the remainders ; then multiply the half sum and the three remain-

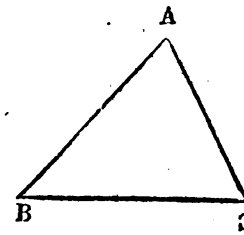
ders continually together, and the square root of the last product will be the Area.

EXAMPLE. Suppose a Triangle whose three sides are 30, 26, and 22.

Sides, 30+25+22 sum 78÷2=39——30=9 and 39—26=13 and 39—22=17, the half sums 39×9×13×17=77571, the square root of which, is equal to 278,5 Chains, or 27 Acres 3 Roods, and 17,5 Poles.

ON THE SLIDING RULE.

EXAMPLE IN TRIGONOMETRY. In the the Oblique Angular Triangle ABC, let there be given AB=56, AC=64, angle ABC 46° 30′, to find the other angles, and the side BC. In this case we have by art, 58 Geometry, the following Canons; as AC 64=Sine ∠B 46° 30′ : : AB 56 : Sine of the Ang. C, to the Ans. And as the Sine ∠B : is to the side AC : : so is the ∠A : BC; therefore to work the first proposition, by the Sliding Rule, we must bring 64, on the Line of numbers, on the fixed part, against 46° 30′ on the Line of Sines on the slider; then against 56 on the fixed part, will be 39° 24′ on the slider, which will be the Angle C. The Angles B and C added together, and their sum being subtracted from 180°, leaves the Angle A =94° 6′. Then by the second Canon being the Angle B =46° 30′ on the Line of Sines, on the slider, against AC=64 on the Line of Numbers on the fixed part; then against the Angle A=94° 6′, or its supplement, 85° 54′ on the slider, will be found the side BC=88 on the fixed part.—In a similar manner may the other propositions of Trigonometry be solved: and from what has been said, it will be easy to work all the problems in Plain Sailing, Middle Latitude Sailing, and Mercator's Sailing, as in the following examples.



EXAMPLE 1. Given the course, sailed 1 point and the distance 85 miles; required the difference of Latitude and Departure?

By Case 1st. of Plain Sailing, we have these Canons:—

As Radius 8 points, is to the distance 85, so is the Sine Compl. of the Course=7 Poin, to the Ans. or difference of Latitude: and as Radius 8 points, is to the Distance 85 so is the Sine Course 1 Point, to the Departure; hence we must bring the Radius 8 points, on the fixed part of the Line Rhombs, against 85 on the Line of Numbers on the slider; then against 7 points on the Line Rhombs will be found the difference of Latitude 83½ on the slider, and against 1 point, will be found the Departure 16½ miles. If the Course is given in Degrees, you must use the Line marked SIN.

EXAMPLE 2. Given the difference of Latitude 40 miles, and Departure 30 miles; required the Course and Distance?

As the difference Latitude 40, is to the Radius 45°, so is the Departure 30, to the Tangent of the Course. Therefore, we must bring 40 on the Line of Numbers found on the slider against 45° on the Line of Tangents, on the fixed part; then against 30 on the slider, will be found the Course 37° nearly.

Again; the Canon for the distance given. As the Sine Course 37°, is to the Departure 30, so is Radius 90° to the Distance. Bring 37° on the Line of Sines, on the fixed part, against 30 on the Line of Numbers, on the slider; then against 90° on the Line of Sines, on the fixed part will be found the distance on the slider.

EXAMPLE 3. Given the middle Latitude Sailing, we have this Canon. As the Sine of Complement of middle Latitude 50°, is to the Departure 30, so is the Radius 90°, to the difference of Longitude. Bring 50° on the Line of Sines on the fixed part, against 30 on the Line of Numbers, on the Slider; then against 90° on the fixed part, will be found 39 on the slider, which will be the difference of the Longitude required.

It may be observed, that in the calculations of Spherical Trigonometry, the Sliding Rule is rather an object of curiosity, than of real use, as it is much more accurate to make those calculations by Logarithms.

How to find the Course when the Base and Perpendicular are given.

RULE. First find the Hypothenuse by the square root, then add one half of the Base to the Hypothenuse. Then

say, as that number is to 86, so is the Perpendicular to the Course.

Example 1. Run North 100 Chains, then West 100 Chains, or Links, or feet, or yards, or miles, or any thing else.

```
   100      100      191,42 : 86° : : 100
    100     100                100
  10000    10000   191,42)8600,00(44° 55′ 38″
  10000                   7656 8
  20000(141,42 Hypoth.     943 20
  1       50 ½ Base        765 68
 24)100                     17752
    96                         60
 281)400                  1065120(55
    281                    957100
2824)11900                 108020
    11296                   95710
28282)60400                 12310
      56564                    60
       3836                 738600(38″
                            57426
                            164340
                            153136
                             11204
```

The Course, but it should be 45°. If instead of 86° for the 2d term, 86,14° had been used, the Ans. would have been 45° 6′ 2″ nearly.

Example 2. Suppose the Base 80 and the Perpendicular 60; what is the Course?

```
   80      60                As 140 : 86,14 : : 60
   80      60                          60
 6400    3600              140)5168,40(36,917°
 3600                          420          60
10000(100 Hypothenuse          968      55,020
10000  40 half Base            840          60
00000 140                     1284       1,200
                              1260
                               0240 Ans. 36° 55′ 1⅕″
                                140
                                100
```

Example for finding the Base and Perpendicular. If you run North, 30° East, 70 Rods, what is your Perpendicular?

1. Radius Rods
60,00 : 70 : : 30°
30
60,00)2100,00(35 Rods.
1800 0
30000
30000
00000

2. Reversed
Radius Rods
69,22 : 70 : : 60°
60
69,22)4200,00(60,67 Rods.
4153 2
46800
41532
52680
48454
4226

A Table of Natural Radii.

°	Radii.		°	Radii.		°	Radii.		°	Radii.	
1	56	880	24	58	986	47	64	240	70	74	544
2	56	922	25	59	141	48	64	563	71	75	105
3	56	967	26	59	300	49	34	895	72	75	661
4	57	017	27	59	466	50	65	238	73	76	293
5	57	072	28	59	637	51	65	590	74	76	942
6	57	130	29	59	815	52	65	950	75	77	608
7	57	193	30	60	000	53	66	323	76	78	292
8	57	260	31	60	190	54	66	705	77	78	994
9	57	331	32	60	388	55	67	098	78	79	714
10	57	407	33	60	592	56	67	502	79	80	453
11	57	488	33	60	804	57	67	917	80	81	211
12	57	573	35	61	021	58	68	343	81	81	990
13	57	664	36	61	246	59	68	781	82	82	784
14	57	757	37	61	479	60	69	231	83	83	623
15	57	857	38	61	719	61	69	692	84	84	452
16	57	961	39	62	967	62	70	166	85	85	317
17	58	071	40	62	222	63	70	653	86	86	205
18	58	180	41	62	485	64	71	153	87	87	116
19	58	306	42	62	617	65	71	666	88	88	052
20	58	431	43	63	036	66	72	193	89	89	013
21	58	562	44	63	323	67	72	734	90	90	000
22	58	693	45	63	620	68	73	289			
23	58	840	46	63	925	69	73	859			

This Table extends from 1° to 90°, and is made by the following

RULE. Divide four times the square of the Comple-

ment, by three times the Complement, add this to 300, and then add the Angle to the quotient.

EXAMPLE 1. Given 10 Degrees.

90 — 80 — 540)25600(47,407
10 — 3 — 2160 — 10 ang. or dg.
80 Conplement 240 — 4000 — 57,407 Ans.
80 — 300 — 3780
6400 sqr. Comp. 540 Divisor — 220,0
4 — 216 0
25600 Dividend — 40,00

EXAMPLE 2. Given the Angle 80 Degrees.

90 — 10×3=30+300=330 — 10
80 — 3
10 Complement. — 30
10 — 300
100 Square of the Complement. — 330 Divisor.
4

330)400(1,212 to which add the Angle
330
700
660
400
330
700

1,212
80
81,212 Ans.

Application and Use of the Radius Table.

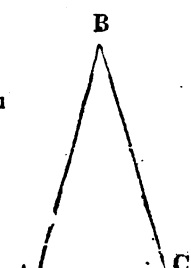
Given the side AB=16,8 Pole, Angle A=58° to find AC.

In the left hand column, under Deg. find 32, and against it, under Radius you will find 60,4, nearly.

Then as 60,4 : 32 : : AB : BC.

16,8
336
504

50,4)537,6(8,9=Side BC.
4832
5440
5436



Then as 68,34 : 58° : : 16,8 ; or as A Radius is to Angle A, so is the Hypothenuse to the Perpendicular.

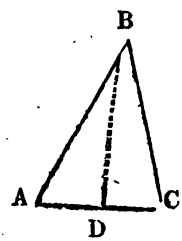
16,8
1344
840

68,34)974,40(14,25 BC.
6834
29100
27336
17640
13668
39720

So that if one Angle, and the Hypothenuse or Course is given of any Right Angled Triangle, the Base and Perpendicular, may easily be found as above.

Oblique Angled Triangles, when the Angles and one side are given, may be solved by the table, by finding the Pependicular.

In the Obliqued Angled Triangle given, AB=100 Miles or Poles, Angle A=60° and Angle C=60° ; required the Perpendicular BD ?



As 60 : 30° : : 100 : 50 AD.
As 69,231 : 60° : : 100 : Ans.

6000
1000

69,231)6000000(86,666 BD Miles, or it may be called Latitude, or Departure, as well as Perpendicular.
553848
461520
415386
461520
415386
459540
415386
441540

Note. By adding any two Angles of a Triangle, together, and subtracting their sum from 180 Degrees, will remain the other Angle. Thus, in the Figure, 60+60=120, which if subtracted from 180, leaves 60, the Angle B.

OF LOGARITHMS.

The usual method of computing the Logarithms to any of the natural numbers, 1 2 3 4 5, &c. is as follows :

Rule. 1. Take any two numbers whose difference is unity, or 1, and let the Log. to the lesser number be known.

2. Divide the constant decimal ,868588964, &c. (or 2÷2,3025, &c.) by the sum of the two numbers, and reserve the quotient; divide the several quotients, by the square of the sum of the two numbers, and reserve the quotient; divide this last quotient, also, by the square of the sum, and again reserve the quotient; and thus proceed. continually dividing the last quotient, by the square of the sum of the two numbers, as long as division can be made.

3. Write these quotients in their order, under one another, the first uppermost, and divide respectively by the prime, or odd numbers, 1 3 5 7 9 11 13, &c. as long as division can be made, that is, divide the first reserved quotient by 1, the second by 3, the third by 5, the fourth by 7, and so on.

4. Add all these last quotients together, and their sum will be the Logarithm of the greater number by the less ;— to this Logarithm, add the Logarithm of the lesser number, and their sum will be the Logarithm to the greater, or proposed number.

Example 1. Let it be required to compute the Logarithm of the number 2. Here the given number is 2, and the next less number is 1, (whose Logarithm is ,0000,) and the sum of 2 and 1 is 3, whose square is 9.

3)868588964	1)289529654	289529654
9)289529654	3)32169962	10723321
9)32169962	5)3574440	714888
9)3574440	7)397160	56737
9)397160	9)44129	4903
9)44129	11)4903	446
9)4903	13)545	42
9)545	15)61	4
9)61		,301029995
	Add Log. of 1.	,000000000
	True Log. of 2	,301029995 Ans.

Example 2. Let it be required to compute the Loga-

rithm of 3. Here the given number is 3, and the next less is 2, whose Logarithm by the first example is 301029995, and the sum of 2 and 3 is 5, and the square of which is 25.

5)868588963	1)173717793	173717793
25)173717793	3)6948712	2316217
25)6948712	5)277948	55590
25)277948	7)11118	1528
25)11118	9)445	50
25)445	11)18	2
25)18		,176091200
	Add Log. of 2,	,301029995
	Logarithm of 3,	477121198 Ans.

As the sum of the Logarithms of numbers gives the Logarithm of their product, and the difference of the Logarithms gives the Logarithm of the quotient of their numbers. From the above two Logarithms, and the Logarithm of 10 which is 1, we may raise a great many Logarithms, as in the following examples.

EXAMPLE 3.

2×2=4 therefore to the

Logarithm of 2,	,301029995
Add Log. of 2,	,301029995
Logarithm of 4,	,602059990

EXAMPLE 4.

2×3=6 therefore, to the

Log. of 2,	,301029995
Add Log. of 3,	,477121255
Log. of 6,	,778151250

EXAMPLE 5.

2×4=8 therefore, to the

Log. of 2,	,301029995
Add Log. of 4,	,602059990
Logarithm of 8,	,903089985

EXAMPLE 6.

10÷2=5 therefore, from

Log. of 10,	1,000000000
take Log. of 2	0,301029995
Log. of 5,	0,698970005

EXAMPLE 7.

5×8=40 therefore, to the

Log. of 8,	,903089985
Add Log. of 5,	,698970005
Log. of 40,	1,602059990

EXAMPLE 8.

8×40=320 therefore, to

Log. 40,	1,602059990
Add Log. 8,	0,903089985
Log. of 320,	2,505149975

And thus computing by this general rule, the Logarithms of the prime numbers, 1 3 5 7 9 11 13 15 17 19 21 23 25, &c. and then by using composition and division, we may easily find as many Logarithms as we please, or examine any in the Table.

Directions for taking Logarithms, and their Numbers from the Table.

Look for the number, whose Logarithm is required, in the Column of Numbers, and against this number, its Logarithm will be found.

Thus; the Logarithm of 1234 is 3,0913151; so that any number less than 10000 may easily be found in the full Table by inspection.

But if the number is greater than 10000, and less than 10000000, cut off four figures on the left of the given number, and find the Logarithm in the Table; add as many units to the Index, as there are figures remaining on the right; subtract the Logarithm found, from the next following it; then as the difference of numbers in the Canon, is to the tabular distance of the Logarithms answering to them, so are the remaining figures of the given number, to the Logarithmic difference; which if it be added to the Logarithm before found, the sum will be the Logarithm required.—Then let the Logarithm of 92375 be required. Cut off the four first figures, 9237, and to the Index of the Logarithm corresponding to them, add one unit, because one figure is cut off, on the right. Then from the Logarithm of the next greater number, 9238=3,9655780, subtract the Log. of the given number, 9237=3,9655309

Indes=10; then* as 10 : 471 : : 5=unit added to 4=to the Index of the Logarithm, corresponding to them; because one figure is cut off, on the right hand, and the Answer will be 235, which added to the Logarithm 4,655309+235=4,9655544=to the Logarithm required.

Or, more briefly, find the Logarithm of the first four figures, as before; then multiply the common difference, which stands against it, by the remaining figures, of the given number; from the product, cut off as many figures at the right hand, as you multiplied by, and add the remainder to the Logarithm before found, fitting it with a proper Index; as the Index must always be one less, than the number of figures in the given natural number; so the Index of the Logarithm for any natural number, less than 10, must be 0; and for any number between 10 and 100, the Index will be 1, and from 100 to 1000, 2 and so on.

* If one figure is cut off, say as 10 is to the difference of the Logarithm; if two figures are cut off, as 100 is to the difference; if three, then say as 1000 is to the difference, &c.

The Logarithm of a decimal fraction, is the same as that of a whole number, excepting the Index. Take out then the Logarithm of a whole number, consisting of the same figures, observing to make the negative Index equal to the distance of the first significant figure of the fraction, from the place of units.

EXAMPLE.

The Log. of	0,07643	is 2,8832639 or 8,8832639
" "	0,00259	is 3,4132998 or 7,4132998
" "	0,0006278	is 4,7978313 or 6,7978213

To find the Logarithm of a mixed Decimal Fraction.

Find the Logarithm in the same manner, as if all the figures were integers; and then prefix the Index belonging to the integral part. Thus, the logarithm of 39,68 is 1,5985717, here the Index is 1, because 1 is the Index of the Logarithm of every number greater than 10, and less than 100.

To find the Logarithm of a Vulgar Fraction.

Subtract the Logarithm of the denominator from that of the numerator, and the difference will be the Logarithm of the fraction.

What is the Logarithm of $\frac{37}{94}$?

Logarithm of 37, 1,5682017

Logarithm of 94, 1,9731279

1,5950738 when the Index is negative.

To find the Natural Number to any Logarithm in the Table.

This is to be done by the reverse of the former, viz. by searching for the proposed Logarithm those in the table, and taking out the corresponding number by inspection, in which the proper number of integers is to be pointed off, viz. one more than the units of the affirmative Index.

To find the Number corresponding to a Logarithm, greater than any in the Table.

Frst, subtract the Logarithm of 10, 100, 1000, or 10000 from the given Log. greater than any in the table till you have a Logarithm that will come within the compass of the table; then find the number corresponding to this, and multiply it by 10, 100, 1000, or 10000 the product will be the number required. Suppose the number corresponding to the Logarithm of 7,7589875 be required. Subtract the Logarithm of the number 10000, which is 4,0000000 from 7,7589875, there remains 3,7589875, the natural number

corresponding to which is 5741 ; this multiplied by 10000 gives the number answering to the given Logarithm =57410000.

MULTIPLICATION BY LOGARITHMS.

Multiplication is performed by taking from the table, Logarithms answering to both factors, and their sum will be the product in Logarithms, the number answering to which, will be the answer. Multiply 45 by 27.

Numbers.	Logarithms.	Numbers.	Logarithms.
45	1.6532125	23,14	1,3643634
27	1,4313638	75,99	1,8807564
1215	3,0845763	175842,86	3,2451198

Multiply 3,586, 0,8372, 0,0294, 2,1046, and add them toghther.

Numbers.	Logarithms.
3,586	0,5546103
2,1046	0,3231696
0,8372	1,9228292
0,0294	2,4683473
0,185768	1,2689564

Here the 2 to be carried from the decimals to the Index.—Cancel the 2, and there remains 1 to be set down.

PRACTICAL EXAMPE. What cost 87 pounds of green tea, $2,12 per pound?

Numbers.	Logarithms.
2,12	0,3263359
87	1,9395193
$184,44	2,2658552

DIVISION BY LOGARITHMS.

RULE. From the Logarithm of the dividend, subtract the Logarithm of the divisor, and the number answering to the remainder, will be the quotient required.

EXAMPLES. Divide 15811 by 165, and 163 by 8,18.

	Numbers.	Logarithm.	Numbers.	Logarithms.
Dividend	15811	4,1989593	Divd. 163	2,2121876
Divisor	163	2,2121876	Divi. 8,18	0,9127533
Quotient	97	1,9867717	Quo. 19,926	1,2994343

PROPORTION, OR RULE OF THREE BY LOG.

RULE. If the proportion be Direct, add the Logarithms of the second and third terms, and subtract from their sum,

the Logarithm of the first term, the remainder will be the term of the Logarithm required.

If the proportion be Inverse, add the Logarithms of the first and second terms, and from their sum, subtract the Logarithm of the third term: the remainder will be the Logarithm to the required term.

EXAMPLE. Find a fourth proportion to 7964, 378, 27960.

	Numbers.	Logarithms.		Numbers.	Logarithms.
2d. term	378	2,5774918			7,0240290
3d. term	27960	4,4465372	1st. term	7964	3,9011313
		7,0240290	4th. term	1327	3,1228977

PRACTICAL EXAMPLE. If 6 yards of cloth cost $5, what will 20 yards cost?

As 6 Log.	0,77815
is to 5 Log.	0,69897
so is 20 Log.	1,30103
Sum of 2d and 3d	2,00000
Subtract first 6	0,77815
Ans. 16,67 Log.	1,22185

The answer, therefore is 16 dollars and $\frac{67}{100}$ or 16 dollars and 67 cents.

EVOLUTION BY LOGARITHMS.

RULE. Divide the Logarithm of the number by the Index of the Power, the quotient is the Logarithm of the root sought. But if the power, whose root is to be extracted is a decimal fraction, less than unity, prefix the Index of its Logarithm, a figure less by one, than the Index of the Power,* and divide the whole by the Index of the Power, and the quotient will be the Logarithm of the root sought.

EXAMPLE 1. What is the square root of 196?

196 Log. 2)2,29226

Ans. 14 Log. 1,14613

EXAMPLE 2. What is the cube root of 27?

27 Log. 3)1,43136

Ans. 3 Log. 0,47712

EXAMPLE 3. What is the square root of 40,96?

40,96 Log. 2)1,61236

Ans. 6,4 Log. 0,80618

EXAMPLE 4. What is the cube root of 0,015625

0,015625 Log. 8,19382

Prefix 2 Index, 3) 28,19392

Ans. 0,25 Log. 9,39794

* In this rule it is supposed that 10 was borrowed in finding the Index of the decimal, according to the rule. Page 97.

LOGARITHMS

OF THE NUMBERS, FROM

1 to 100.

No.	Log.	N.	Log.	N.	Log.	N.	Log.
1	0. 000000	26	1. 414973	51	1. 707570	76	1. 880814
2	301030	27	431364	52	716003	77	886491
3	477121	28	447158	53	724276	78	892095
4	602060	29	462398	54	732394	79	897627
5	698970	30	477121	55	740363	80	903090
6	778151	31	491362	56	748188	81	908485
7	845098	32	505150	57	755875	82	913814
8	903090	33	518514	58	763428	83	919078
9	954243	34	531479	59	770852	84	924279
10	1. 000000	35	544068	60	778151	85	929419
11	041393	36	556303	61	785330	86	934498
12	079181	37	568202	62	792392	87	939519
13	113943	38	579784	63	799341	88	944483
14	146128	39	591065	64	806180	89	949390
15	176091	40	602060	65	812913	90	954243
16	204120	41	612784	66	819544	91	959041
17	230469	42	623249	67	826075	92	963789
18	255273	43	633468	68	832509	93	968483
19	278754	44	643453	69	838849	94	973128
20	301030	45	653213	70	845098	95	977724
21	322219	46	662758	71	851258	96	982271
22	342423	47	672098	72	857333	97	986772
23	361738	48	681241	73	863323	98	991226
24	380211	49	690196	74	869232	99	995635
25	397940	50	698970	75	875061	100	2. 000000

No.	0	1	2	3	4	5	6	7	8	9
100	2.000000	2.009434	2.000868	3.001301	2.001734	2.002166	2.00 598	2.003029	2.003461	2.003891
101	04321	04751	05181	05609	06038	06466	06894	07321	07748	08174
102	08600	09026	09451	09876	10300	10722	11147	11570	11993	12415
103	12837	13259	13680	14100	14521	14940	15360	15779	16197	16616
104	17033	17451	17868	18284	18700	19116	19532	19947	20361	20775
105	21189	21603	22016	28422	22841	23252	23664	24075	24486	24896
106	25306	25715	26125	26533	26942	27350	27757	28164	28571	28978
107	29384	29789	30195	30600	31004	31408	31812	32216	32619	33021
108	33424	33826	34227	34628	35029	35430	35830	36230	36629	37028
109	37426	37825	38223	38620	39017	39414	39811	40207	40602	40998
110	41393	41787	42182	42576	42969	43362	43755	44148	44540	44932
111	45323	45714	46105	46495	46885	47275	47664	48053	48442	48830
112	49218	49606	49993	50380	50766	51153	51538	51924	52309	52694
113	53078	53463	53846	54230	54613	54996	55378	55760	56142	56524
114	56905	57286	57666	58040	58426	58805	59185	59563	59942	60320
115	60698	61075	61452	61829	62206	62582	62958	63333	63709	64083
116	64458	64832	65206	65580	65953	66326	66699	67071	67443	67815
117	68186	68557	68928	69298	69668	70038	70407	70776	71145	71514
118	71882	72250	72617	72985	73352	73718	74085	74451	74816	75182
119	75547	75912	76276	76640	77004	77368	77731	78094	78457	78819
120	79181	79543	79904	80266	80626	80987	81347	81707	82067	82426
121	82785	83144	83503	83861	84219	84576	84934	85291	85647	86004
122	86360	86716	87071	87426	87781	88136	88490	88845	89198	89552

No.	0	1	2	3	4	5	6	7	8	9
1 3	2.099905	2.990258	2.090611	2.090963	2.091315	2.091667	2.092018	2.092370	2.092721	2.093071
124	93422	93772	94122	94471	94820	95169	95518	95866	96215	96562
125	96910	97257	97604	97951	98298	98644	98990	99335	99681	100026
126	100371	100715	101059	101403	101747	102091	102434	102777	103119	03462
127	03804	04146	04487	04828	01569	05510	05851	06191	06531	06871
128	07210	07549	07888	08227	08565	08903	09241	09579	09916	10253
129	10590	10926	11263	11599	11934	12270	12605	12940	13275	13609
130	13943	14277	14611	14944	15278	15611	15943	16276	16608	16940
131	17271	17603	17934	18265	18595	18926	19256	19586	19915	20245
132	20574	20903	21231	21560	21888	22216	22544	22871	23198	23525
133	23852	24178	24504	24830	25156	25481	25806	26131	26456	26781
134	27105	27429	27753	28076	28399	28722	29045	29368	29690	30012
135	30334	30655	30977	31298	31619	31939	32260	32580	32900	33219
136	33539	33858	34177	34496	34814	35133	35451	35769	36086	36403
137	36721	37037	37354	37671	37987	38303	38618	38934	39249	39564
138	39879	40194	40508	40822	41136	41450	41763	42076	42389	42702
139	43015	43327	43639	43951	44263	44574	44885	45196	45507	45818
140	46128	46438	46748	47058	47367	47676	47985	48294	48603	48911
141	49219	49527	49835	50142	50449	50756	51063	51370	51676	51982
142	52288	52594	52900	53205	53510	53815	54120	54424	54728	55032
143	55336	55640	55943	56246	56549	56852	57154	57457	57759	58061
144	58362	58664	58965	59266	59567	59868	60168	60469	60769	61068
145	61368	61667	61967	62260	62564	62863	63161	63460	63758	64055

No.	0	1	2	3	4	5	6	7	8	9
146	2.164353	2.164650	2.164947	2.165244	2.165541	2.165838	2.166134	2.166430	2.166726	2.167022
147	67317	67613	67908	68203	68497	68792	60086	69380	69674	69968
148	70262	70555	70848	71141	71434	71726	72019	72311	72603	72895
149	73186	73478	73769	74060	74351	74641	74932	75222	75512	75802
150	76091	76381	76670	76959	77248	77536	77825	78113	78401	78689
151	78977	79264	79552	79839	80126	80413	80699	80986	81272	81558
152	81844	82129	82415	82700	82985	83270	83555	83839	84123	84407
153	84691	84975	85259	85542	85825	86108	86391	86674	87956	87239
154	87521	87803	88084	88366	88647	88928	89209	89490	89771	90051
155	90332	90612	90892	91171	91451	91730	92010	92289	92567	92846
156	93125	93403	93681	93959	94237	94514	94792	95069	95346	95623
157	95899	96176	96453	96729	97005	97281	97556	97832	98107	98382
158	98657	98932	99206	99481	99755	200029	200303	200577	200850	201124
159	201397	201670	201943	202216	202488	02261	03033	03305	03577	03848
160	04120	04391	04663	04934	05204	05475	05746	06016	06286	06556
161	06826	07096	07365	07634	08904	08173	08442	08710	08979	09247
162	09515	09783	10051	10319	10586	10853	11121	11388	11654	11921
163	12188	12454	12720	12986	13252	13518	13783	14049	14314	14579
164	14844	15109	15373	15638	15902	16166	16430	16694	16957	17221
165	17484	17747	18010	18273	18536	18798	19060	19323	19585	19846
166	20108	20370	20631	20892	21153	21414	21675	21936	22196	22456
167	22716	22976	23236	2349	23755	24015	24274	24533	24792	25051
168	25309	25568	25826	26084	26342	26600	26885	27115	27372	27630

No.	0	1	2	3	4	5	6	7	8	9
169	2.227887	2.228144	1.228400	2.228657	2.228913	2.229170	2.229426	2.229682	2.229938	2.230193
170	30449	30704	30960	31215	31470	31724	31979	32234	32288	32742
171	32996	33250	33504	33757	34011	34264	34517	34770	35023	35276
172	35528	35781	36033	36285	36537	36789	37041	37292	37544	37795
173	38046	38297	38548	38799	39049	39299	39550	39800	40050	40300
174	40549	40799	41048	41297	41546	41795	42044	42293	42541	42790
175	43038	43286	43534	43782	44030	44277	44525	44772	45019	45266
176	45513	45759	46006	46252	46499	46745	46991	47237	47482	47728
177	47973	48219	48464	48709	48954	49198	49443	49687	49932	50176
178	50420	50664	50908	51151	51395	51638	51881	52125	52369	52610
179	52853	53096	53338	53580	53822	54064	54306	54548	54790	55031
180	55273	55514	55755	55996	56237	56477	56718	56958	57198	57439
181	57679	57918	58158	58398	58637	58877	59116	59355	59594	59833
182	60071	60310	60548	60787	61025	61263	61501	61739	61976	62214
183	62451	62688	62925	63162	63399	63636	63873	64109	64346	64582
184	64818	65054	65290	65525	65761	65996	66232	66467	66702	66937
185	67172	67406	67641	67875	68110	68344	68580	68812	69046	69279
186	69513	69746	69980	70213	70446	70679	70912	71144	71377	71609
187	71842	72074	72306	72538	72770	73001	73233	73464	73696	73927
188	74158	74389	74620	74850	75031	75311	75542	75772	76002	76232
189	76462	76692	76921	77151	77380	77609	77838	78067	78296	78525
190	78754	78982	79211	79439	79667	79895	80123	80351	80578	80806
191	81033	81261	81488	81715	81942	82169	82396	82622	82849	83075

A TRAVERSE TABLE, OR

DIFFERENCE OF LATITUDE AND DEPARTURE,

When 1 minute is calculated to 5 minutes, and from thence to 10, 15, 20 and so on to 60 minutes or one degree; and from 1 degree to 1 degree and 30 minutes, and to 2 degres, and so on to 90 degrees: and any distance from 1 to 9 poles or chains, by which it may be understood to extend from 10 to 90, or from 100 to 900, or from 1000 to 9000, or from 10000 to 90000, observing to move the separatrix one or more places to the right hand, as the number of cyphers on the right of the integral distance will denote, and the rest will be decimals, the two first of which, on the hand, may at all times be called links, when the distance is given in chains and links.

Note. Difference of Latitude is called Northing and Southing. Departure, Meridian Distance, or Longitude are the same as Easting and Westing.

To find the Latitude and Departure, for any Course and Distance.

If the Course be more than 45° look for it in the column marked Latitude; if lesr than 45° look for it in the column marked Departure; and look for the Distance at the righ or left hand columns: against the Distance, and directly under the Course, stand the Latitude, or Northing, &c. in whole numbers and decimals.

If the Course be less than 45°, the Northing and Southing, will be greater than the Departure, or Easting and Westing, but if more than 45°, the Easting and Westing will be the greatest.

When the Distance exceeds 9, 90, or 900, &c. it will be a Multiple of some numbers, from 1 to 9, or from 10 to 90, &c. Suppose the Distance to be 16, which is a Multiple of 8: double the numbers found against 8, in both Latitude and Departure, and you will have the respective results: for example; suppose the Course 13° 30′, and the Distance 16 Chains. Under 13° 30′, we find under Latitude, 7,778664; this multiplied by 2, gives 15,557328, for the Departure: against 8 we find 1,867488, which multiplied by 2 gives 3,734976, which is the answer, for 16. If the

Distance be 17, to the number before found for 16, add the number against 1 : or for 19, double the number against 9, to which add the number against 1 ; and for 20, look against 2, and remove the separatrix one place to the right hand, and so for 30, 40, 50, 60, &c.

Suppose the Course N. 27° 30′ E. and Distance from 3 to 30000.

	Latitude.		Departure.
3	2,660931	3	1,385193
30	26,60931	30	13,85193
300	266,0931	300	138,5193
3000	2660,931	3000	1385,193
30000	26609,31	30000	13851,93

The above Distance may be called Chains, and then the two figures of decimals, next to the separatrix, will be Links or decimals of a Chain.

Again, suppose the Course 22°, and the Distance 70 Chains. Against 7, the Latitude will be 6,490 ; or call it 70, and then remove the point, one place to the right :— thus, 64,90, and so of Departure ; 2,622, altered, makes 26,22 Links, &c.

Suppose the Course as above, and the Distance 70 Links more than the respective Distance. Look against 7, and remove the separatrix one place to the left hand, and then the two decimals will be Links ; as against 7 you will find 6,208, altered, will be 62,08=to 62 Links, and so of any other number of Links, as they are governed by the same laws as whole numbers.

Dist.	Departure 1′	Departure. 2′	Departure. 3′	Departure 4′	Dist.
1	0.000291	0.000582	0.000873	0.001164	1
2	0.000582	0.001164	0.001746	0.002328	2
3	0.000873	0.001746	0.002619	0.003492	3
4	0.001164	0.002328	0.003492	0.004656	4
5	0 001455	0.002910	0.004365	0.005820	5
6	0.001746	0.003492	0.005538	0.006984	6
7	0.002037	0.004074	0.006111	0.008148	7
8	0.002328	0.004656	0.006994	0.009312	8
9	0.002619	0.005238	0.007857	0.010476	9
	5′	10′	15′	20′	
1	0.001454	0.002908	0,004336	0.005817	1
2	0 002908	0 005818	0 008672	0 011634	2
3	0 004362	0 008727	0 013008	0 017451	3
4	0 005816	0 011636	0 017348	0 023268	4
5	0 007270	0 014545	0 021680	0 029085	5
6	0 008724	0 017454	0 026016	0 034902	6
7	0 010178	0 020363	0 030352	0 040719	7
8	0 011632	0 023272	0 034688	0 046536	8
9	0 013086	0 026181	0 039024	0 052353	9
	25′	30′	35′	40′	
1	0.007272	0.008726	0.010170	0.011635	1
2	0 014544	0 017452	0 020340	0 023270	2
3	0 021816	0 026178	0 030510	0 034905	3
4	0 029088	0 034904	0 040680	0 046540	4
5	0 036360	0 043630	0 050850	0 058775	5
6	0 043632	0 052356	0 061020	0 079810	6
7	0 050904	0 061082	0 071190	0 081445	7
8	0 058176	0 069808	0 081360	0 093080	8
9	0 065448	0 078534	0 091530	0 104715	9
	45′	50′	55′		
1	0.013089	0.014543	0.015997		1
2	0 026178	0 029086	0 031994		2
3	0 039267	0 043629	0 047991		3
4	0 052356	0 058172	0 063988		4
5	0 065445	0 072715	0 679985		5
6	0 078524	0 087258	0 095982		6
7	0 091623	0 101801	0 111979		7
8	0 104722	0 116344	0 127976		8
9	0 117801	0 138870	0 143973		9

Dis.	Latitude, 89°	Departure, 1°	Latitude, 88° 30′	Departure, 1° 30′	Dis.
1	0.999848	0.017452	0.999619	0.026175	1
2	1 999696	0 034904	1 999238	0 052350	2
3	2 999544	0 052356	2 998851	0 078525	3
4	3 999392	0 069808	3 998476	0 104700	4
5	4 999240	0 087260	4 998082	0 130875	5
6	5 999088	0 104712	5 997702	0 157050	6
7	6 998936	0 122164	6 997327	0 183225	7
8	7 998784	0 133916	7 996952	0 209400	8
9	8 998632	0 157068	8 996565	0 235574	9
	88°	2°	87° 30′	2° 30′	
1	0.999848	0.034899	0.999010	0.043617	1
2	1 999696	0 069798	1 998020	0 087234	2
3	2 999544	0 104697	2 997030	0 130851	3
4	3 999392	0 139596	3 986040	0 174468	4
5	4 999240	0 174495	4 995050	0 218085	5
6	5 999088	0 209394	5 994060	0 261702	6
7	6 998936	0 244293	6 993070	0 305319	7
8	7 998782	0 279192	7 992080	0 348936	8
9	8 998532	0 314091	8 991090	0 392553	9
	87°	3°	86° 30′	3° 30′	
1	0.998630	0.053336	0.998097	0.061046	1
2	1 997260	0 104672	1 096194	0 122092	2
3	2 995890	0 157008	2 994291	0 183138	3
4	3 995520	0 209344	3 993388	0 244184	4
5	4 993150	0 261680	4 990485	0 305230	5
6	5 991780	0 314016	5 988585	0 366276	6
7	6 991410	0 366352	6 986679	0 427322	7
8	7 991040	0 418688	7 984776	0 488368	8
9	8 988670	0 471024	8 982873	0 549114	9
	86°	4°	85° 30′	4° 30′	
1	0.997564	0.069756	0.996879	0.078456	1
2	1 995128	0 139512	1 993758	0 156912	2
3	2 992692	0 209268	2 990637	0 235368	3
4	3 990256	0 279024	3 987516	0 313824	4
5	4 987820	0 348780	4 984395	0 392280	5
6	5 985384	0 418536	5 981274	0 470736	6
7	6 982948	0 488292	6 988153	0 549192	7
8	7 980512	0 558048	7 975032	0 637648	8
9	8 978076	0 627804	8 971911	0 706204	9

Dis.	Latitude. 85°	Departure. 5°	Latitude. 84° 30′	Departure. 5° 30′	Dist.
1	0.996195	0.087156	0.995358	0.095842	1
2	1 992390	0 174312	1 990716	0 191684	2
3	2 988590	0 261468	2 986074	0 287526	3
4	3 985780	0 348624	3 981432	0 383368	4
5	4 980980	0 435780	4 986790	0 479210	5
6	5 977180	0 522936	5 972148	0 575052	6
7	6 974370	0 610092	6 977506	0 670894	7
8	7 971560	0 697248	7 962864	0 766736	8
9	8 966760	0 784404	8 968222	0 862578	9
	84°	6°	83° 30′	6° 30′	
1	0.994522	0.104528	0.993534	0.113198	1
2	1 989044	0 209056	1 987068	0 226396	2
3	2 983566	0 314084	2 980602	0 339594	3
4	3 978088	0 418112	3 974136	0 452792	4
5	4 972610	0 523140	4 967670	0 565990	5
6	5 967132	0 628168	5 961204	0 679198	6
7	6 961654	0 732196	6 954738	0 792386	7
8	7 956176	0 836224	7 948272	0 905584	8
9	8 950698	0 941252	8 941806	1 018782	9
	83°	7°	82° 30′	7° 30′	
1	0.992546	0.121869	0.991407	0.130521	1
2	1 985092	0 243738	1 982814	0 261042	2
3	2 977598	0 365607	2 974221	0 391563	3
4	3 970184	0 487476	3 965628	0 522084	4
5	4 952650	0 609345	4 957035	0 652605	5
6	5 955196	0 731214	5 948442	0 793126	6
7	6 948702	0 853083	6 939849	0 913647	7
8	7 940368	0 974952	7 931256	1 044168	8
9	8 922754	1 096821	8 931663	1 174689	9
	82°	8°	81° 30′	8° 30′	
1	0.990268	0.139173	0.988978	0.147803	1
2	1 980536	0 278346	1 977956	0 295606	2
3	2 970804	0 417519	2 966934	0 443409	3
4	3 961072	0 556692	3 955912	0 591212	4
5	4 951340	0 695865	4 944890	0 739015	5
6	5 941608	0 835038	5 933868	0 886818	6
7	6 931876	0 974311	6 922846	1 034621	7
8	7 922144	1 113384	7 911824	1 182424	8
9	8 912412	1 252557	8 900802	1 330227	9

Dist.	Latitude, 81°	Departure. 9°	Latitude. 80° 30′	Departure. 9° 30′	Dist.
1	0.987688	0.156434	0.986248	0.165041	1
2	1 975376	0 312868	1 972596	0 330082	2
3	2 963064	0 469302	2 958844	0 495123	3
4	3 950752	0 625736	3 944192	0 660164	4
5	4 934440	0 782170	4 931440	0 825205	5
6	5 926128	0 938604	5 917688	0 990246	6
7	6 913816	1 095038	6 903036	1 155287	7
8	7 901504	1 251472	7 888384	1 320328	8
9	8 889192	1 407906	8 876632	1 485369	9
	80°	10°	79° 30′	10° 30′	
1	0.984808	0.173648	0.983217	0.182229	1
2	1 969616	0 357296	1 966434	0 364458	2
3	2 954424	0 520944	2 949651	0 546687	3
4	3 939232	0 694592	3 932868	0 728916	4
5	4 924040	0 868240	4 916085	0 911145	5
6	5 908848	1 041888	5 899302	1 093374	6
7	6 893656	1 215536	6 882519	1 275603	7
8	7 878464	1 389184	7 865736	1 457832	8
9	8 863272	1 562832	8 848953	1 640061	9
	79°	11°	78° 30′	11° 30′	
1	0.981627	0.190810	0.979887	0.199361	1
2	1 963254	0 381620	1 959774	0 398722	2
3	2 954881	0 572430	2 939661	0 598083	3
4	3 926508	0 763240	3 919548	0 797444	4
5	4 908135	0 954050	4 899435	0 996805	5
6	5 889762	1 144860	5 879322	1 196166	6
7	6 871389	1 335670	6 859209	1 395527	7
8	7 853016	1 526480	7 839096	1 594888	8
9	8 834643	1 717290	8 818983	1 794249	9
	78°	12°	77° 30′	12° 30′	
1	0.978148	0.207912	0.976259	0.216431	1
2	1 956296	0 415824	1 952418	0 432862	2
3	2 934444	0 623736	2 928677	0 649293	3
4	3 912592	0 831648	3 904836	0 865724	4
5	4 890740	1 039560	4 881095	1 082155	5
6	5 868888	1 247472	5 857354	1 298586	6
7	6 847036	1 455386	6 833513	1 515017	7
8	7 825184	1 663296	7 809672	1 731448	8
9	8 803332	1 871208	8 786331	1 947879	9

Dist.	Latitude. 77°	Departure. 13°	Latitude. 76° 30′	Departure. 13° 30′	Dist.
1	0.974370	0.224951	0.972333	0.233436	1
2	1 948740	0 449901	1 944666	0 466872	2
3	2 923110	0 674853	2 916999	0 700308	3
4	3 897480	0 899804	3 889332	0 933744	4
5	4 871850	1 124755	4 861665	1 167180	5
6	5 846220	1 349706	5 833998	1 400616	6
7	6 820590	1 574657	6 806331	1 634052	7
8	7 795960	1 799608	7 778664	1 867488	8
9	8 769330	2 024559	8 750997	2 100924	9
	76°	14°	75 30′	14° 30′	
1	0.970296	0.241922	0.968111	0.250370	1
2	1 940592	0 483844	1 936222	0 500740	2
3	2 910888	0 725766	2 904333	0 751110	3
4	3 881184	0 967688	3 872444	1 001480	4
5	4 851480	1 209610	4 840555	1 251850	5
6	5 821776	1 451532	5 808666	1 502220	6
7	6 792072	1 693454	6 776777	1 752590	7
8	7 762368	1 935376	7 744888	2 002960	8
9	8 732664	2 177298	8 712999	2 253330	9
	75°	15°	74° 30′	15° 30′	
1	0.965926	0.258819	0.963594	0.267228	1
2	1 931852	0 517638	1 927188	0 534456	2
3	2 897778	0 776457	2 900782	0 801684	3
4	3 863704	1 035276	3 874376	1 069112	4
5	4 839630	1 294095	4 837970	1 336340	5
6	5 795556	1 552914	5 801564	1 603568	6
7	6 761482	1 811733	6 775158	1 870896	7
8	7 727408	2 070552	7 748752	2 138224	8
9	8 703334	2 329371	8 712346	2 405452	9
	74°	16	73° 30′	16° 30′	
1	0.961262	0.275637	0.958783	0.284004	1
2	1 922524	0 551274	1 917566	0 568008	2
3	2 883786	0 826911	2 876349	0 852012	3
4	3 845048	1 102548	3 835132	1 136016	4
5	4 806310	1 378185	4 793915	1 420020	5
6	5 767572	1 653822	5 752698	1 704024	6
7	6 724834	1 929459	6 711481	1 988028	7
8	7 690096	2 205096	7 670264	2 272032	8
9	8 651358	2 480733	8 629047	2 556036	9

	Latitude. 73°	Departure. 17°	Latitude. 72 30′	Departure. 17° 30′	Dist.
1	0.956305	0.292372	0.953681	0.300694	1
2	1 912610	0 584744	1 907362	0 601388	2
3	2 878915	0 877116	2 861043	0 902082	3
4	3 825220	1 169488	3 814724	1 202776	4
5	4 781525	1 461860	4 768405	1 503470	5
6	5 737830	1 754232	5 722086	1 804164	6
7	6 693135	2 046604	6 675767	2 104858	7
8	7 650440	2 338976	7 629448	2 405552	8
9	8 606745	2 631348	8 583129	2 706246	9
	72°	18°	71° 30′	18 30′	
1	0.951057	0.309017	0.948288	0.317292	1
2	1 902114	0 618034	1 896576	0 634584	2
3	2 853171	0 927051	2 834864	0 951876	3
4	3 804228	1 236068	3 793152	1 269168	4
5	4 755285	1 545085	4 741440	1 586460	5
6	5 706342	1 854102	5 689728	1 903752	6
7	6 657399	2 163119	6 638016	2 221044	7
8	7 608456	2 472136	7 586304	2 538328	8
9	8 559513	2 781153	8 534392	2 855628	9
	71°	19°	70° 30′	19° 30′	
1	0.945519	0.325568	0.942606	0.333794	1
2	1 391038	0 651136	1 883212	0 667588	2
3	2 836557	0 976704	2 827818	1 001382	3
4	3 782076	1 302272	3 770424	1 335176	4
5	4 727595	1 627940	4 713030	1 668970	5
6	5 673114	1 953408	5 655636	2 002764	6
7	6 618733	2 278976	6 698242	2 336558	7
8	7 564142	2 604544	7 540848	2 670352	8
9	8 509671	2 930212	8 483454	3 004116	9
	70°	20°	69° 30′	20° 30′	
1	0.939693	0.342020	0.936636	0.350194	1
2	1 879386	0 684040	1 873272	0 700388	2
3	2 819079	1 026060	2 809908	1 050582	3
4	3 758772	1 368080	3 747544	1 400776	4
5	4 698465	1 710100	4 683180	1 750970	5
6	5 638158	2 052120	5 619816	2 100164	6
7	6 577851	2 394140	6 557452	2 451358	7
8	7 517544	2 738160	7 495088	2 801552	8
9	8 457227	3 078180	8 430724	3 151746	9

Dist.	Latitude. 69°	Departure. 21°	Latitude. 68° 30′	Departure. 21°.30′	Dist.
1	0.933580	0.358368	0.930382	0.366487	1
2	1 867160	0 716736	1 860764	0 732974	2
3	2 800740	1 075104	2 791146	1 099461	3
4	3 734320	1 433572	3 721528	1 465948	4
5	4 667900	1 791840	4 651910	1 832435	5
6	5 601480	2 150208	5 582292	2 198922	6
7	6 535060	2 508676	6 512674	2 565409	7
8	7 468640	2 867144	7 443056	2 931896	8
9	8 402220	3 225412	8 373438	3 298383	9
	68°	22°	67° 30′	22° 30′	
1	0.927184	0.374607	0.923844	0.382669	1
2	1 854368	0 749214	1 847688	0 765338	2
3	2 781552	1 123821	2 771532	1 148007	3
4	3 708736	1 498428	3 695376	1 530676	4
5	4 635920	1 873035	4 621220	1 912445	5
6	5 563104	2 247644	5 543064	2 296014	6
7	6 490288	2 622249	6 466908	2 678683	7
8	7 417472	2 997856	7 390752	3 061352	8
9	8 344656	3 371463	8 316596	3 444121	9
	67°	23°	66° 30′	23° 30′	
1	0.920505	0.390731	0.917025	0.398734	1
2	1 841010	0 781462	1 834050	0 797468	2
3	2 761515	1 172193	2 751075	1 196202	3
4	3 682020	1 562924	3 668100	1 594936	4
5	4 602725	1 953655	4 585125	1 993670	5
6	5 523030	2 344386	5 502150	2 392404	6
7	6 442535	2 735117	6 419175	2 792138	7
8	7 364040	3 125948	7 336200	3 189872	8
9	8 284745	3 516579	8 253225	3 589606	9
	66°	24°	65° 30′	24° 30′	
1	0.913545	0.406737	0.909926	0.414677	1
2	1 827090	0 813474	1 819852	0 829354	2
3	2 740635	1 220211	2 729778	1 244031	3
4	3 654180	1 626948	3 639704	1 658708	4
5	4 567725	2 033685	4 549630	2 073385	5
6	5 481370	2 440422	5 459556	2 488062	6
7	6 394815	2 847179	6 369482	2 803739	7
8	7 308360	3 253896	7 279408	3 317416	8
9	8 221905	3 660633	8 189324	3 732093	9

Dist.	Latitude. 65°	Departure. 25°	Latitude. 64° 30′	Departure. 25 30′	Dist.
1	0.906308	0.422613	0.902551	0 430494	1
2	1 812616	0 845236	1 805102	0 860988	2
3	2 718924	1 267854	2 707653	1 291482	3
4	3 625232	1 690472	3 610204	1 721976	4
5	4 531540	2 113090	4 512755	2 152470	5
6	5 437848	2 535708	5 415306	2 582964	6
7	6 344156	2 958316	6 317857	2 014458	7
8	7 250464	3 380924	7 220408	3 443952	8
9	8 156772	3 803562	8 122959	3 874446	9
	64°	26°	63° 30′	26 30′	
1	0.898798	0.438371	0.894901	0.446131	1
2	1 797596	0 876742	1 789802	0 892362	2
3	2 696394	1 315113	2 684703	1 338543	3
4	3 695192	1 753484	3 579604	1 784724	4
5	4 493990	2 191855	4 474505	2 230905	5
6	5 392788	2 630226	5 369406	2 677086	6
7	6 291586	3 068597	6 264307	3 123267	7
8	7 190384	3 506968	7 159208	3 569448	8
9	8 088182	3 945339	8 044109	4 015629	9
	6 3°	27°	62° 30′	27 30′	
1	0.891007	0.453990	0.886977	0.461731	1
2	1 782014	0 907980	1 773954	0 923462	2
3	2 673021	1 361970	2 660931	1 385193	3
4	3 564028	1 815960	3 547908	2 846924	4
5	4 455035	2 269950	4 434885	2 308655	5
6	5 346042	2 723940	5 321862	2 770386	6
7	6 237049	3 177930	6 208832	3 232117	7
8	7 128056	3 631920	7 095816	3 693848	8
9	8 019063	4 085910	7 982793	4 155589	9
	62°	28°	61° 30′	28 30′	
1	0.882948	0.469472	0.878784	0.477141	1
2	1 765896	0 938944	1 757568	0 954282	2
3	2 648844	1 408416	2 636352	1 431423	3
4	3 531792	1 877888	3 515136	1 908564	4
5	4 424740	2 347360	4 393920	2 385705	5
6	5 297688	2 816832	5 272704	2 862846	6
7	6 180636	3 286304	6 151486	3 339987	7
8	7 063544	3 755776	7 030272	3 817138	8
9	7 946532	4 225248	7 909056	4 294269	9

Dist.	Latitude. 61°	Departure. 29°	Latitude. 60° 30′	Departure. 29° 30′	Dist.
1	0.874620	0.484810	0.870322	0.492405	1
2	1 749240	0 969620	1 740644	0 984810	2
3	2 623860	1 454430	2 610966	1 477215	3
4	3 498480	1 939240	3 481288	1 969620	4
5	4 373100	2 424050	4 351610	2 462025	5
6	5 247720	2 908860	5 221932	2 954430	6
7	6 122340	3 393670	6 092254	3 446835	7
8	6 996960	3 878480	6 972576	3 939240	8
9	7 871580	4 363290	7 832898	4 431645	9
	60°	30°	59° 30′	30° 30′	
1	0.866025	0.500000	0.861596	0.507519	1
2	1 732050	1 000000	1 723192	1 015038	2
3	2 598075	1 500000	2 584788	1 522557	3
4	3 464100	2 000000	3 446384	2 030076	4
5	4 330125	2 500000	4 327980	2 537595	5
6	5 198150	3 000000	5 169576	3 045114	6
7	6 062175	3 500000	6 031172	3 552633	7
8	6 928200	4 000000	6 892768	4 060152	8
9	7 794225	4 500000	7 754364	4 567671	9
	59°	31°	58° 30′	31° 30′	
1	0.857167	0.515038	0.852607	0.522478	1
2	1 714334	1 030076	1 705214	1 044956	2
3	2 571501	1 556114	2 557821	1 567434	3
4	3 428668	2 060152	3 410428	2 089912	4
5	4 285835	2 515190	4 263035	2 612390	5
6	5 143002	3 090228	5 115642	3 134868	6
7	6 000169	3 603266	5 968249	3 657346	7
8	6 857336	4 120304	6 820856	4 179824	8
9	7 714503	4 635342	7 673463	4 702302	9
	58°	32°	57° 30′	32° 30′	
1	0.848048	0.529919	0.843359	0.537279	1
2	1 696096	1 059838	1 686718	1 074558	2
3	2 544144	1 589757	2 530077	1 612837	3
4	3 392192	2 119676	3 373436	2 149116	4
5	4 240240	2 649595	4 216795	2 687395	5
6	5 088288	3 179514	5 060154	3 225674	6
7	5 936336	3 709433	5 903513	3 761953	7
8	6 784384	4 239352	6 746872	4 298232	8
9	7 632432	4 769271	7 590231	4 836511	9

Dist.	Latitude. 57°	Departure. 33°	Lrtitude. 56° 30′	Departure. 33° 30′	Dist.
1	0.838671	0.544639	0.833854	0.551916	1
2	1 677342	1 089278	1 667708	1 103832	2
3	2 516013	1 633917	2 001562	1 655748	3
4	3 354684	2 178556	3 335416	2 207664	4
5	4 193355	2 723195	4 169270	2 759580	5
6	5 032026	3 267834	5 003124	3 311496	6
7	5 870697	3 812473	5 836978	3 863412	7
8	6 709368	4 357112	6 670832	4 415328	8
9	7 548039	4 901751	7 504686	4 967244	9
	56°	34°	55° 30′	34° 30′	
1	0.829038	0.559193	0.824145	0.566384	1
2	1 658076	1 118386	1 648290	1 132768	2
3	2 587114	1 677579	2 472435	1 699152	3
4	3 316152	2 236772	3 296580	2 265536	4
5	4 145190	2 795965	4 120725	2 831920	5
6	5 974228	3 355158	4 944870	3 398304	6
7	5 803266	3 914351	5 769015	3 964688	7
8	6 632304	4 473544	6 593160	4 531072	8
9	7 461342	5 032737	7 417305	5 097456	9
	55°	35°	54° 30′	35° 30′	
1	0.819152	0.573576	0.814084	0.580630	1
2	1 638304	1 147152	1 628168	1 161260	2
3	2 457456	1 720728	2 442252	1 741890	3
4	3 276608	2 294304	3 256336	2 322520	4
5	4 095760	2 867980	4 070420	2 903150	5
6	4 914912	3 441456	4 884504	3 483780	6
7	5 734064	4 015032	5 698588	4 064410	7
8	6 553216	4 588608	6 512672	4 645040	8
9	7 372368	5 162084	7 326756	5 225670	9
	54°	36°	53° 30′	36° 30′	
1	0.809017	0.587785	0.803826	0.594800	1
2	1 618034	1 175570	1 607652	1 189600	2
3	2 427051	1 763365	2 411478	1 784400	3
4	3 236068	2 351140	3 215304	2 379200	4
5	4 045085	2 938925	4 019130	2 974000	5
6	4 854102	3 526710	4 822956	3 568800	6
7	5 763119	4 114495	5 626782	4 163600	7
8	6 472136	4 702280	6 430608	4 758400	8
9	7 281153	5 290065	7 234434	5 353200	9

Dist.	Latitude. 53°	Departure. 37°	Latitude. 52° 30′	Departure. 37° 30′	Dist.
1	0.798636	0.601815	0.793323	0.608738	1
2	1 597272	1 203630	1 586646	1 217476	2
3	2 395908	1 805445	2 379969	1 826214	3
4	3 194344	2 407260	3 173292	2 434952	4
5	3 993180	3 009075	3 966615	3 043690	5
6	4 791816	3 610890	4 759938	3 652428	6
7	5 590252	4 212705	5 553261	4 261166	7
8	6 388688	4 814580	6 346584	4 869904	8
9	7 187524	5 416335	7 139907	5 478642	9
	52°	38°	51° 30′	38° 30′	
1	0.788011	0.615661	0.782578	0.622490	1
2	1 576022	1 231322	1 565156	1 244980	2
3	2 364033	1 846983	2 347734	1 867470	3
4	3 152044	2 462644	3 130312	2 489960	4
5	3 940055	3 078305	3 912890	3 112450	5
6	4 728066	3 693966	4 695468	3 734940	6
7	5 516077	4 309627	5 478046	4 357430	7
8	6 304088	4 925288	6 260624	4 979920	8
9	7 092099	5 540949	7 043202	5 602410	9
	51°	39°	50° 30′	39° 30′	
1	0.777146	0.629320	0.771595	0.636054	1
2	1 554292	1 258640	1 543190	1 272108	2
3	2 331438	1 887960	2 314785	1 908162	3
4	3 108544	2 517280	3 086380	2 544216	4
5	3 885730	3 146600	3 857975	3 180270	5
6	4 662876	3 775920	4 629570	3 816324	6
7	5 440022	4 205240	5 401165	4 452378	7
8	6 217168	5 034560	6 172760	5 088432	8
9	6 994314	5 663880	6 944355	5 724486	9
	50°	40°	49° 30′	40° 30′	
1	0.766044	0.642788	0.760377	0.649423	1
2	1 532088	1 285576	1 520754	1 298846	2
3	2 298132	1 928364	2 281131	1 948269	3
3	3 064176	2 571152	3 041508	2 597692	4
5	3 830220	3 213940	3 801885	3 247115	5
6	4 596264	3 856728	4 562262	3 896538	6
7	5 362308	4 499516	5 322639	4 545961	7
8	6 128252	5 142304	6 083016	5 195384	8
9	6 894396	5 785092	6 843393	5 844807	9

Dist.	Lat. 49°	Dep. 41°	Lat. 48° 30′	Dep. 41° 30′	Lat, 45°	Dist.
1	0.754710	0.656059	0.748927	0.662595	0.707107	1
2	1 509420	1 312118	1 497854	1 325190	1 414214	2
3	2 264130	1 968177	2 246781	1 987785	2 121321	3
4	3 018840	2 624236	2 995708	2 650380	2 828428	4
5	3 773550	3 280295	3 744635	3 312975	3 535535	5
6	4 528260	3 936354	4 493562	3 975570	4 242642	6
7	5 282970	4 592413	5 242489	4 638165	4 949749	7
8	6 037680	5 248472	5 991816	5 300760	5 656856	8
9	6 792390	5 904531	6 740343	5 963355	6 363963	9
	48°	42°	47° 30′	42° 30′		
1	0.743145	0.669131	0.737249	0.675564		1
2	1 486290	1 338262	1 474498	1.351128		2
3	2 229435	2 007393	2 211747	2 026692		3
4	2 972580	2 676524	2 948996	2 702256		4
5	3 715725	3 346655	3 686245	3 379920		5
6	4 458870	4 014786	4 423494	4 053384		6
7	5 202015	4 683817	5 160743	4 718948		7
8	5 945160	5 353048	5 897992	5 404512		8
9	6 688205	6 023179	6 634241	6 080076		9
	47°	43°	46° 39′	43° 30′		
1	0.731354	0.681998	0.725347	0.688328		1
2	1 462708	1 363996	1 450794	1 376656		2
3	2 194062	2 045094	2 176041	2 064984		3
4	2 925416	2 727992	2 801388	2 753312		4
5	3 656770	3 409990	3 626735	3 441640		5
6	4 388124	4 091988	4 352082	4 129968		6
7	5 119478	4 773986	5 077429	4 818296		7
8	5 850832	5 455984	5 802776	5 506624		8
9	6 582186	6 137982	6 528123	6 194952		9
	46°	44°	45° 30′	44° 36′	Lat. 88°	
1	0.719340	0.694653	0.713223	0,700882	0.999391	1
2	1 438680	1 389316	1 426446	1 401764	1.998782	2
3	2 158020	2 083974	2 139669	2 102646	2 998173	3
4	2 877360	2 778632	2 852892	2 803528	3 997564	4
5	3 596700	3 473280	3 566125	3 504410	4 996955	5
6	4 316040	4 167948	4 279338	4 205292	5 996346	6
7	5 035380	4 862606	4 992561	4 906174	6 995737	7
8	5 754720	5 557264	5 705784	5 607056	7 995128	8
9	6 474060	6 251922	6 419007	6 307938	8 994519	9

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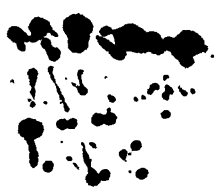
ERRATA. The 61 and 62 pages, should have been in the place of the 66 and 67 pages, or between the tables of square timber and round timber.—The line at the bottom of the 87 page should be at the top.—In the Traverse table, page 108, under 88 degrees Latitude, is wrong, and it will be found corrected, under Latitude 45 degrees, page 118.